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NAS FORT WORTH  
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FINAL WORK PLAN FOR AREA OF CONCERN 20 SITE INSPECTION WITH ATTACHED  
RESPONSE TO COMMENTS NAS FORT WORTH TX  
11/1/2000  
SCIENCE APPLICATIONS INTERNATIONAL CORPORATION



**NAVAL AIR STATION  
FORT WORTH JRB  
CARSWELL FIELD  
TEXAS**

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**ADMINISTRATIVE RECORD  
COVER SHEET**

AR File Number 687

# **AOC 20 SITE INSPECTION NAS FORT WORTH JRB, TEXAS SCOPING DOCUMENTS**

## **FINAL**



**U.S. Air Force Center for Environmental Excellence  
Brooks AFB, Texas**

**Contract No. F41624-00-D-8030  
Delivery Order No. 0007**

## **NOVEMBER 2000**

**Response to Technical Review Comments**  
**Draft Scoping Documents for**  
**AOC 20 Site Inspection**  
**Naval Air Station Joint Reserve Base**  
**Fort Worth, Texas**  
**October 2000**

Item	Page	Section	Line	Comment	SAIC Response
<b>Work Plan</b>					
1	1-1	1.1	13	Please change "paleochannel" to "paleochannel"	Text revised as requested.
2	1-1	1.1	14	Please change "...and is the preferential pathway..." to "...that may serve as a preferential pathway..."	Text revised as requested
3	1-1	1.1	16&17	Please revise the sentence to read "...to remediate the "southern plume", part of a larger trichloroethene (TCE) dissolved phase plume originating primarily from Air Force Plant 4"	Text revised as requested
4	1-1	1.1	21&22	Please add that a TCE isopleth map will also be generated as part of the deliver order	Text revised as requested.
5	1-1	1.1	25	Please add "Region 6" after "(USEPA)"	Text revised as requested.
6	1-1	1.1	26	Please add "Region 6 Superfund Division" after "the EPA".	Text revised as requested.
7	1-1	1.1	27&28	Please add "(ROD)" after "Record of Decision" and "(CERCLA)" after "Comprehensive Environmental Response, Compensation, and Liability Act". Also, please add the acronyms to the list at the beginning of the document.	Text revised and acronyms added as requested
8	1-1	1.1	1-9	It is recommended that the contractor discuss the Health and Safety Plan before the Field Sampling Plan in order to be consistent with the order in which the plans are listed in the binder.	Assumed that page reference should read "1-3". Text revised as requested
9	1-6	1.2 3.1	42	The text indicates that "aqueous discharge from OWSs was and still is, pumped into the sanitary sewers". However, this is not the case, some discharge also goes to the storm water interceptors. Please revise the sentence accordingly.	Sentence revised to read "... aqueous discharge from OWSs was pumped into the sanitary sewers"
10	1-7	1.3	32	Please insert a comma after "Air Force".	Text revised as requested
11	1-7	1.3	33	Please change "NAS Fort Worth" to "NAS Fort Worth"	Text revised as requested.
12	2-4	2.1 3.2	11	Please change the sentence to read "In an area of AFP 4, known as the "window area", the Goodland/Walnut Aquitard"	Text revised as requested.

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Item	Page	Section	Line	Comment	SAIC Response
13	2-4	2.1.3.3	24	Please revise the sentence to read “. which uses Lake Worth among its water sources ”	Text revised as requested
14	2-8	2.2.1	23-24	Please insert a comma after “Paleochannels” and “River”.	Text revised as requested.
15	2-9	2.2.2	17	Please insert “into the groundwater” after “TCE”	Text revised as requested.
16	2-9	2.2.2	18	Please insert “operational” between “past” and “disposal”	Text revised as requested.
17	2-9	2.2.2	20	Please insert “oriented” after “Fort Worth JRB”.	Text revised as requested
18	2-9	2.2.2	20	Please revise the sentence to read “These paleochannels act as a preferred pathways for .”	Text revised as requested
19	2-9	2.2.2	21	Please revise the sentence to read: The paleochannel <i>that is assumed to serve as a preferential pathway for the Southern Lobe</i> crosses the .”	Text revised as requested
20	2-9	2.2.2	35	It is recommended that the contractor add verbiage from the recent BRAC drum removal activities at SWMU 24. Also, the text indicates that the Final RFI Report for SWMU 24 will be submitted in Summer 2000. Please revise the submittal date.	Lines 25 through 38 were deleted, as work done at SWMU 24 is not applicable to AOC 20
21	2-10	2.2.2	12	Please revise the sentence to read “ remediated prior to leaving Federal property in accordance with the AFP 4 ROD.”	Text revised as requested
22	2-10	2.2.3	32	Please add the sentence: “An assessment of the aqueduct integrity is currently on-going ” to the end of the paragraph	Text revised as requested.
23	2-11	2.2.3	6	Please add the sentence. “An ecological risk assessment of Farmer’s Branch Creek is currently on-going.” at the end of the paragraph	Text revised as requested.
24	3-1	3.1	12	This sentence is unclear. It is recommended that the sentence be re-phrased	Text revised as follows

**Response to Technical Review Comments**  
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Item	Page	Section	Line	Comment	SAIC Response
25	3-2	Table 3-1	NA	The table indicates that six borings will be advanced a maximum of 60 ft. However, per the statement of work (SOW), the borings will be advanced to 45 ft. It is recommended that the depth be changed to be consistent with the SOW.	"60 feet" was replaced with "45 feet," consistent with the SOW
26	3-2	Table 3-1	NA	The table indicates that "three samples will be collected from three deep wells at the center of the plume." However, it is unclear as to which "deep wells" the contractor is referring to. Please clarify.	The "deep well" locations have yet to be determined
27	3-3	3.5	7	Please change "Building 1916 and the Drum Storage Yard" to "Building 1619 and the IDW yard."	Text revised as requested
28	3-3	3.5.1	NA	It is recommended that the contractor include previous seismic work from CH2MHill and Parsons.	Revised line 29 to read "groundwater monitoring wells, soil boring locations, and seismic data as possible."
29	3-5	Figure 3-1	NA	It is recommended that the contractor indicate which existing wells will be sampled by highlighting them. Also, "Paleochannel" (From Parsons Engineering Science, 1998) is listed as part of the legend, however, the paleochannel information is not shown on the figure. It is recommended that the paleochannel be shown on the figure.	Figure was revised as requested
30	3-7	3.5.2	2	Please change "imagining" to "imaging."	Text revised as requested
31	3-7	3.5.4	NA	It is recommended that the contractor indicate whether the new monitoring wells will be flush mounted with concrete pads.	Text revised as requested
32	3-7	3.5.4	33	It is recommended that the contractor check with HydroGeoLogic to ensure that all proposed sampling wells were not abandoned, etc.	SAIC will ensure that all proposed sampling wells are able to be sampled
33	3-9	3.5.5	6	Please change "1929" to "1998".	NA (reference to year deleted as unnecessary)
34	4-3	4.3	9	Please change the beginning of the sentence to read "A draft <i>Informal Technical Information Report (TIR)</i> will be completed." Also, please add TIR to the acronyms list at the beginning of the document.	Text revised as requested

**Response to Technical Review Comments**  
**Draft Scoping Documents for**  
**AOC 20 Site Inspection**  
**Naval Air Station Joint Reserve Base**  
**Fort Worth, Texas**  
**October 2000**

Item	Page	Section	Line	Comment	SAIC Response
<b>Health and Safety Plan</b>					
1	1-1	1.1	12	Please change "ship" to "strip".	Text revised as requested.
2	1-1	1.2	37	Please add that the Contractors Officer Representative (COR) or Contracting Officer (CO) will be notified in the event of suspension of on-site activities.	Text revised as requested.
3	3-1	3.1.1	13-15	The "field office" indicated in the text no longer exists. Please revise the sentence to read: "The primary staging area for field equipment and supplies will be located at the <i>Investigation Derived Waste (IDW) Yard inside the main gate off of Military Parkway.</i> "	Text revised as requested.
4	3-1	3.2	25-26	This sentence is unclear. It is recommended that the sentence be re-phrased.	Text revised as requested.
5	3-1	3.2	29	Please insert "approximate" between "The" and "location".	Text revised as requested.
6	3-3	3.6	4	Please see Work Plan comment #27.	Text revised as requested.
7	3-3	Table 3-1	NA	Please see Work Plan comment #25.	"60 feet" was replaced with "45 feet," consistent with the SOW.
8	3-3	Table 3-1	NA	Please see Work Plan comment #26.	The "deep well" locations have yet to be determined.
9	9-1	9.1	2	Please change "Requirements for HydroGeoLogic Personnel" to "Requirements for SAIC personnel".	Text revised as requested.
10	13-3	Table 13-1	NA	Please change Michael Dodyk's phone number to (817) 782-7167.	Text revised as requested.
11	13-3	Table 13-1	NA	Please change "Directions to Nearest Medical Facility" to "Directions to Harris Hospital".	Text revised as requested.

**Response to Technical Review Comments**  
**Draft Scoping Documents for**  
**AOC 20 Site Inspection**  
**Naval Air Station Joint Reserve Base**  
**Fort Worth, Texas**  
**October 2000**

Item	Page	Section	Line	Comment	SAIC Response
<b>Field Sampling Plan</b>					
1	2-2	2.2	6	Please change the sentence to read: "...top of bedrock, basal gravel thickness, and TCE isopleth maps."	Text revised as requested
2	2-2	2.3	NA	It is recommended that the section include a reference to the Figure 3 site map from the Work Plan	Text revised as requested
3	4-2	Table 4-1	NA	Please change Michael Dodyk's phone number to (817) 782-7167.	Text revised as requested
4	5-2	5.2	23	The text indicates that "The field office and primary staging area for field equipment and supplies will be located at 6560 White Settlement Road", however, this address no longer exists. It is recommended that the sentence be revised to indicate that the primary staging area for field equipment is the IDW Yard	Text revised as requested
5	5-2	5.3.1	37	Please revise the sentence to read "All drilling activities shall be performed by a professional well driller licensed by the state of Texas, and shall conform with state "	Text revised as requested
6	5-4	5.4.1	28	Please revise the sentence to read: "...will obtain and pay for all permits, applications, utility clearances, and other documents..."	Text revised as requested.
7	5-4	5.4.1	30	Please change "Base civil engineer" to "Base Public Work Officer".	Text revised as requested
8	6-8	6.2.2	20	Please change "HydroGeoLogic designation (e.g. HGL)" to "SAIC designation"	Text revised as requested
9	6-8	6.2.2	28	Please change "HGL" to "SAIC"	Text revised as requested

NA – Not Applicable



# **AOC 20 SITE INSPECTION NAS FORT WORTH JRB, TEXAS**

## **SCOPING DOCUMENTS**

### **FINAL**

**TAB 1: Work Plan**

**TAB 2: Health and Safety Plan**

**TAB 3: Field Sampling Plan**



**U.S. Air Force Center for Environmental Excellence  
Brooks AFB, Texas**

**Contract No. F41624-00-D-8030  
Delivery Order No. 0007**

**NOVEMBER 2000**

# TAB

*Work Plan*

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**AOC 20 SITE INSPECTION  
NAS FORT WORTH JRB, TEXAS**

**WORK PLAN**

**FINAL**

Prepared for

U.S. Air Force Center for Environmental Excellence  
Brooks Air Force Base, Texas

Prepared by

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION  
San Antonio, Texas

Contract No. F41624-00-D-8030  
Delivery Order No. 0007

November 2000

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## ACRONYMS AND ABBREVIATIONS

1,1,1-TCA	1,1,1-trichloroethane
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AFP 4	Air Force Plant 4
AGE	aerospace ground equipment
AOC	area of concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DRMO	Defense Reutilization and Marketing Office
EI	electrical imaging
ERD	Environmental Restoration Division
ESE	Environmental Science and Engineering, Incorporated
FSP	Field Sampling Plan
GC	gas chromatograph
HGL	HydroGeoLogic, Incorporated
HQ	Headquarters
HSP	Health and Safety Plan
IS	internal standard
ITIR	Informal Technical Information Report
JP-4	jet propulsion grade 4 fuel
JRB	Joint Reserve Base
MCL	maximum contaminant level
MEK	methyl ethyl ketone
MS	matrix spike
MSD	matrix spike duplicate
NAS	Naval Air Station
NGVD	National Geodetic Vertical Datum
NPL	National Priorities List
OWS	oil/water separator
PD-680	petroleum naphtha
PRB	permeable reactive barrier
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QC	quality control

**ACRONYMS AND ABBREVIATIONS (cont.)**

Radian	Radian Corporation
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
Rust	Rust Geotech
SAC	Strategic Air Command
SI	Site Inspection
SWMU	solid waste management unit
TCE	trichloroethene
TNRCC	Texas Natural Resource Conservation Commission
TOC	total organic carbon
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

**Abbreviations**

cm/sec	centimeters per second
°F	degrees Fahrenheit
ft/day	feet per day
gpd/ft <sup>2</sup>	gallons per day per square foot
J	qualitatively identified
R	rejected
U	estimated
µg/L	micrograms per liter



## PREFACE

Science Applications International Corporation (SAIC) has been tasked to perform a Site Inspection (SI) of Area of Concern (AOC) 20 at the Naval Air Station (NAS) Fort Worth Joint Reserve Base (JRB), former Carswell Air Force Base (AFB), Texas. This Work Plan describes the work that will be conducted to delineate preferential groundwater pathways (gravel channels/paleochannels) in the southern lobe of the regional trichloroethene (TCE) plume. Work will be conducted under Contract Number F41624-00-D-8030, Delivery Order (DO) Number 0007. SI activities will include:

- Performance of a seismic survey.
- Performance of an electrical imaging (EI) survey.
- Determination of the Walnut/Goodland aquitard topography.
- Identification of the basal gravel portions of the terrace alluvial deposits overlying the bedrock.
- Production of an updated conceptual site model.

Responsible essential SAIC personnel are as follows:

David K. Dougherty	Program Manager
Robert W. Bauer, P.E.	Project Manager
Yuequn Jin, Ph.D.	Project Hydrogeologist

This contract will be administered by the Environmental Contracting Division, Human Systems Center (HSC/PKV), located at the Headquarters (HQ), United States (U.S.) Air Force Center for Environmental Excellence (AFCEE), 3207 North Road, Brooks AFB, Texas 78235-5363. The Contracting Officer is Ms. Leticia Walton. The Buyer is Mr. Mario M. Martinez. The Contracting Officer's Representative is Mr. Don Ficklen (210-536-5290), Environmental Restoration Division, HQ AFCEE (HQ AFCEE/ERD).

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## 1. INTRODUCTION

This Work Plan describes the overall objectives of the Site Inspection as well as the technical approach to completing actions necessary to meet those objectives.

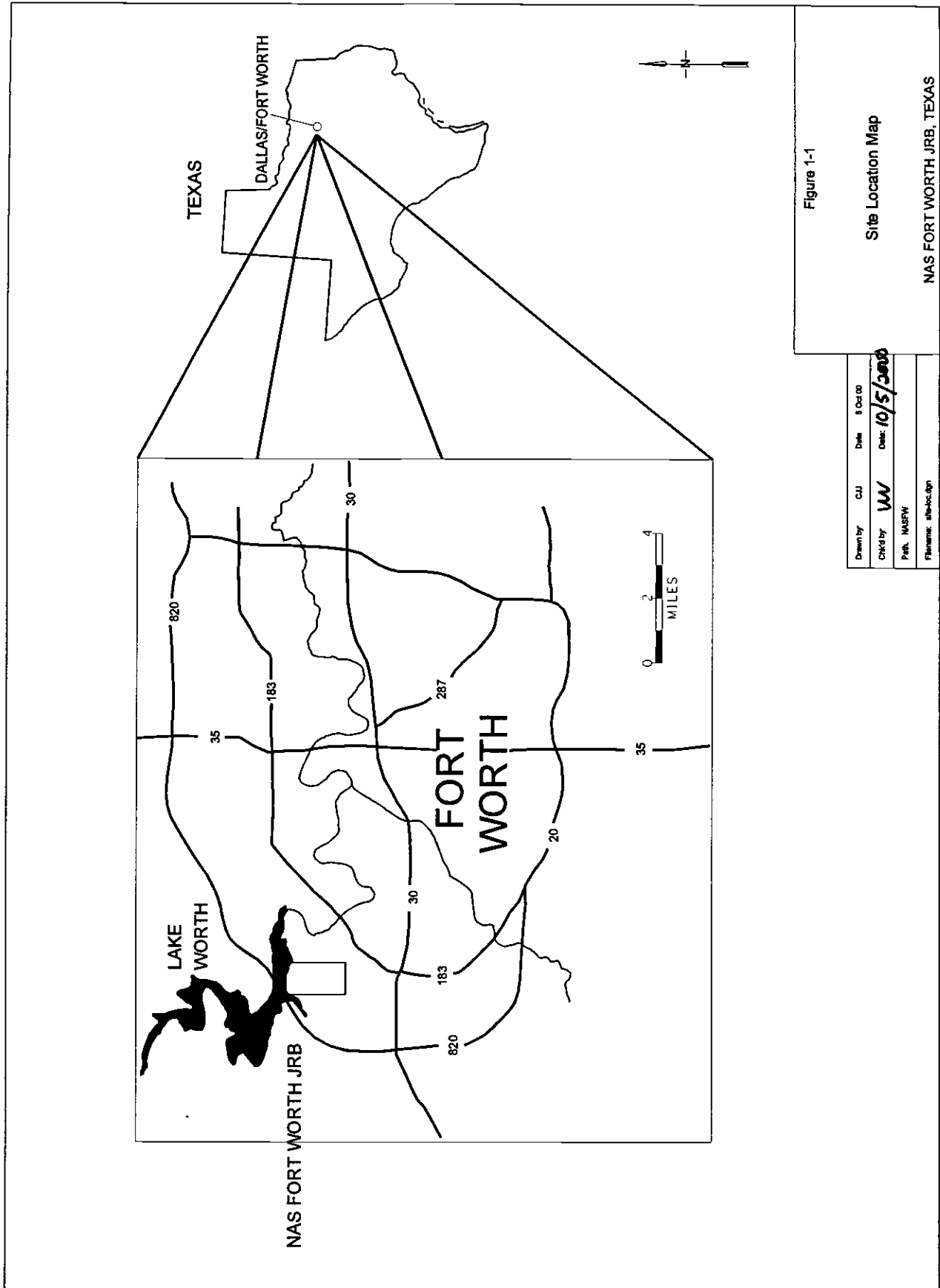
### 1.1 BACKGROUND

Carswell Air Force Base (AFB) was officially closed on 30 September 1993. A parcel of the former base now known as Naval Air Station (NAS) Fort Worth Joint Reserve Base (JRB) (Figure 1-1), has been transferred from United States (U.S.) Air Force (USAF) to U.S. Navy management. Before complete property transfer can be accomplished, required environmental investigations of potential contamination related to Air Force activities occurring prior to 30 September 1993 at the NAS Fort Worth JRB property are to be complete, and contaminated sites are to be remediated.

The focus of this work is a Site Inspection (SI) at Area of Concern (AOC) 20 using geophysical techniques. "AOC 20" refers to a paleochannel beneath NAS Fort Worth JRB that may serve as a preferential pathway for groundwater and contaminants (HydroGeoLogic, Incorporated [HGL] 2000c). The objective of the SI is to provide information to support the siting of the permeable reactive barrier (PRB) that is planned to remediate the southern plume, part of a larger trichloroethene (TCE) dissolved phase plume originating primarily from Air Force Plant 4. The geophysical techniques used in performance of the SI will be seismic surveying and electrical imaging. The geophysical surveys will be used to determine the Walnut/Goodland aquitard topography and to delineate gravel channels (paleochannels) in the aquitard. The conceptual site model for AOC 20 will be updated, top of bedrock, basal gravel thickness, and TCE isopleth maps will be generated. This Work Plan outlines the procedures for the performance of the geophysical surveys and subsequent data analysis.

The primary regulatory agencies that govern the SI are the U.S. Environmental Protection Agency (USEPA) Region 6 and the Texas Natural Resource Conservation Commission (TNRCC). The USEPA is the lead regulatory agency for activities to be conducted at the subject site. The site is currently regulated by the Air Force Plant 4 (AFP 4) Record of Decision (ROD) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This Work Plan was prepared using guidance documents from the USEPA Region 6 Superfund Division, the Texas Natural Resources Conservation Commission (TNRCC), and the Headquarters Air Force Center for Environmental Excellence (HQ AFCEE). The Work Plan for this project consists of the following documents:

The Work Plan presents project objectives and describes the work to be performed. The Work Plan describes the site history and setting and provides a summary of environmental investigations that have been completed at the base. Descriptions of the planned geophysical surveys are included in this Work Plan. Technical reports and presentation formats are also briefly discussed in the Work Plan.



The Health and Safety Plan (HSP) provides guidance and procedures to satisfy health and safety regulations. The HSP describes required monitoring procedures, personal protection, and site safety protocols. Medical surveillance procedures, site control, and emergency response procedures are also described. In addition, potential health and safety risks for the SI are identified.

The Field Sampling Plan (FSP) describes the planned field sampling procedures. Each analytical method that will be used is described in detail. Mobilization activities, environmental sampling procedures, and a field quality control (QC) program are also discussed.

## **1.2 HISTORY OF PAST WORK AT THE INSTALLATION**

This section describes the location and operational history of the NAS Fort Worth JRB and AFP 4 and summarizes previous environmental investigations conducted at the site.

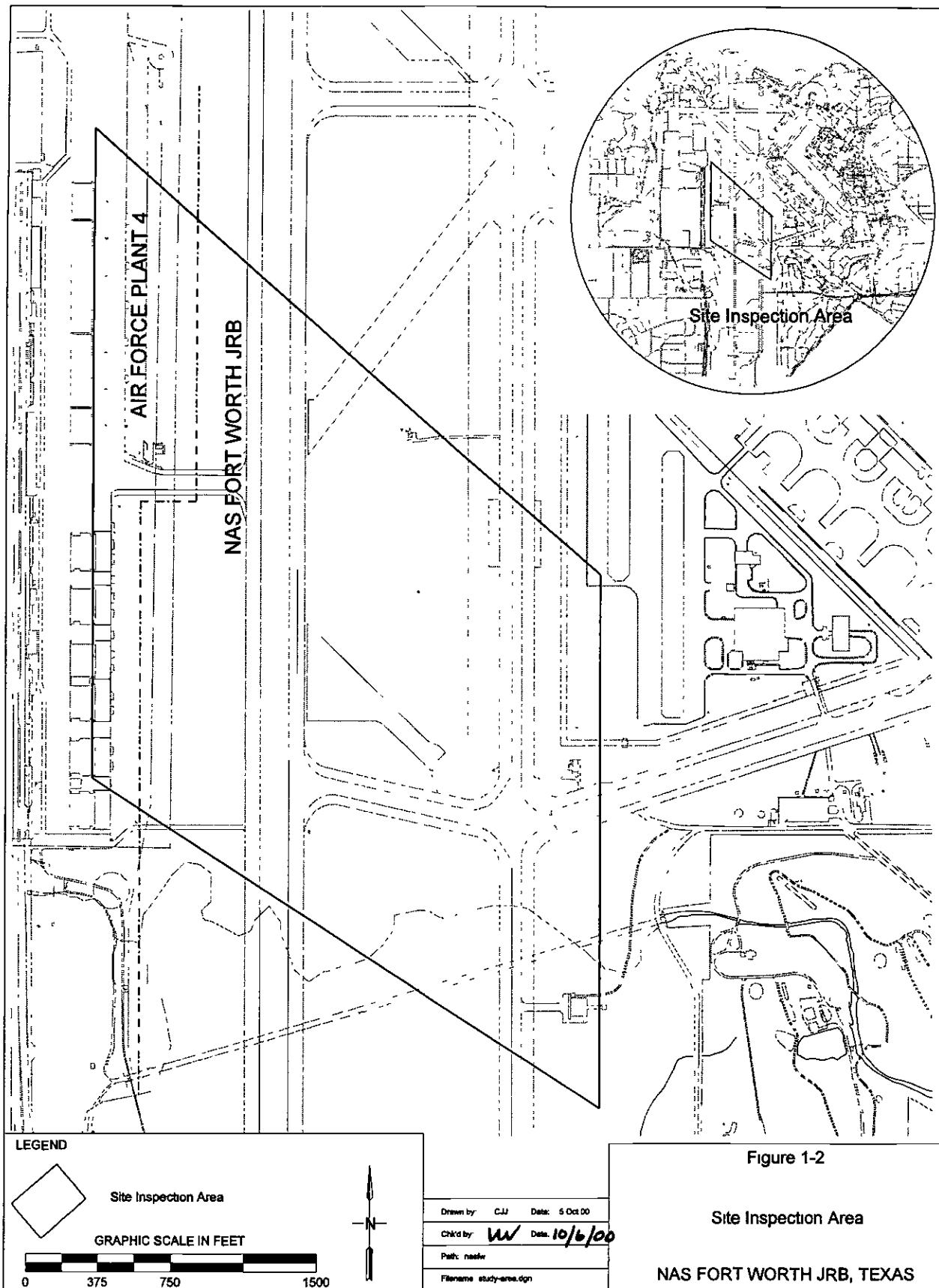
### **1.2.1 Installation Description**

NAS Fort Worth JRB is located on 2,555 acres of land in Tarrant County, Texas, 8 miles west of downtown Fort Worth (Figure 1-1). It consists of the main base and two noncontiguous parcels (the Instrument Landing System marker beacon and the Weapons Storage Area) located west of the city of White Settlement. The main base comprises 2,264 acres and is bordered by Lake Worth to the north, the West Fork of the Trinity River, the city of River Oaks, and the city of Westworth Village to the east, other urban areas of Fort Worth to the northeast and southeast, the city of White Settlement to the west and southwest, and AFP 4 to the west.

AFP 4 occupies 602 acres and employs people in various positions pertaining to aircraft manufacturing and associated processes. The area surrounding NAS Fort Worth JRB not used for Department of Defense operations is primarily suburban. Land use in the immediate vicinity of the base is industrial, commercial, residential, and recreational (Kearney 1989).

### **1.2.2 Installation History and Present Mission**

Before the initial base construction in 1941, the area that is now occupied by the NAS Fort Worth JRB consisted of woods and pasture in an area called White Settlement. The NAS Fort Worth JRB started as a modest dirt runway built to service the aircraft manufacturing plant formerly located at AFP 4's current location. Figure 1-2 presents the geographic relationship between AFP 4 and the NAS Fort Worth JRB in the study area.



In August 1942, the base was opened as Tarrant Field Airdrome and was used to train pilots to fly B-24 bombers under the jurisdiction of the Gulf Coast Army Air Field Training Command. In May 1943, the field was re-designated as Fort Worth Army Air Field with continued use as a training facility for pilots. The Strategic Air Command (SAC) assumed control of the installation in 1946, and the base served as the headquarters for the Eighth Air Force. It was renamed Carswell Air Force Base in 1948, and the 7th Bomber Wing became the base host unit. The Headquarters 19th Air Division was relocated to Carswell AFB in 1951, where it remained until September 1988 (Kearney 1989).

The SAC mission remained at Carswell AFB until 1992, when the Air Combat Command assumed control of the base upon disestablishment of SAC. In October 1994, the U.S. Navy assumed responsibility for much of the facility, and its name was changed from Carswell AFB to NAS Fort Worth JRB. The NAS Dallas and elements of Glenview and Memphis NASs were combined and joined to NAS Fort Worth JRB to streamline naval operations into one central area. The principal activities on the base have been maintaining and servicing bombers, fuel tankers, and fighter jet aircraft (Kearney 1989).

AFP 4 became operational in 1942 when Consolidated Aircraft began manufacturing the B-24 bomber for national defense during World War II. In 1953, General Dynamics took over operation of the manufacturing facility. Since 1953, AFP 4 has produced B-36, B-58, and F-111 aircraft. The plant currently produces F-16 aircraft. In addition to F-16 aircraft, AFP 4 produces spare parts, radar units, and missile components. On 1 March 1993, Lockheed, Fort Worth Company, took over operations of AFP 4 as a successor to General Dynamics (HGL 2000c).

### **1.2.3 Site Operational History**

A summary of past and current industrial activities and waste disposal operations conducted at the NAS Fort Worth JRB and AFP 4 is presented in the following sections.

#### **1.2.3.1 Industrial Activities**

Major industrial operations that have been performed at the NAS Fort Worth JRB include the following: maintenance of jet engines, aerospace ground equipment (AGE), fuel systems, weapons systems, pneudraulic systems, and general and special purpose vehicles; aircraft corrosion control; and non-destructive inspection activities. Most of the liquid wastes that have been generated by industrial operations can be characterized as waste oils, recoverable fuels, spent solvents, and spent cleaners (CH2M Hill 1984).

Waste oils generally refer to lubricating fluids/oils and, to a lesser extent, hydraulic fluids. Recoverable fuels refer to fuels drained from aircraft tanks and other base vehicles, such as jet propulsion grade 4 fuel (JP-4) and unleaded gasoline. Spent solvents and cleaners refer to stripping liquids used for degreasing and cleaning of the following: aircraft, aircraft systems and parts, electronic components, and vehicles. Spent solvents and cleaners include PD-680 (petroleum naphtha) and various chlorinated organic

compounds. Specific types of degreasing solvents used by the USAF have changed over the years. Carbon tetrachloride was commonly used in the 1950s until it was replaced by TCE around 1960. Since then, TCE and 1,1,1-trichloroethane (1,1,1-TCA) have been used, although TCE usage has decreased in favor of 1,1,1-TCA. Today, PD-680 (Type II), 1,1,1-TCA, and to a limited extent, TCE are used. In additions, waste paint solvents and strippers are generated on-site from corrosion control activities. Typical paint solvents include the following compounds: isobutyl acetate, toluene, methyl ethyl ketone (MEK), isopropanol, naphtha, and xylene. Paint strippers generally contain such compounds as methylene chloride, toluene, ammonium hydroxide, and phenolics. Servicing and maintaining the engines and equipment of the B-52 and KC-135 aircraft generated the majority of waste liquids at NAS Fort Worth JRB (CH2M Hill 1984).

Manufacturing operations at AFP 4 have resulted in the generation of various hazardous wastes that include waste oils, fuels, spent solvents, paint residues, and spent process chemicals. Throughout most of the plant's history, waste oil, solvents, and fuels were disposed at on-site landfills or were burned during fire training exercises. Chemical wastes were initially discharged to the sanitary sewer system and treated by the City of Fort Worth's treatment system. In the 1970s, chemical process wastes were treated on site at a newly constructed chemical waste treatment system before being discharged to the sanitary sewer system. Currently, a contractor disposes waste oils and solvents, and burning of these wastes has been discontinued. Chemical wastes continue to be treated on site. AFP 4 was placed on the National Priorities List (NPL) in August 1990 (HGL 2000c).

### 1.2.3.2 Waste Disposal Operations

Wastes have been generated and disposed of at the NAS Fort Worth JRB since the beginning of industrial operations in 1942. Historical waste management practices at the NAS Fort Worth JRB were presented in the *Phase I Initial Assessment Report* (CH2M Hill 1984), the *Phase I Remedial Investigation Report* [Radian Corporation (Radian) 1989], and the *Site Characterization Summary Informal Technical Information Report* (CH2M Hill 1996a), and are summarized in the following paragraphs:

1942–1970: The majority of waste oils, recovered fuels, spent solvents, and cleaners were burned at the fire department training areas during practice exercises. Some waste oils and spent solvents were disposed of through contractor removal, while some waste paints (contaminated with thinners and solvents), waste oils, and PD-680 are suspected of having been disposed of in the base landfills. Some waste oils, recovered fuels, spent solvents, and cleaners were also discharged to sanitary and storm sewers. These discharges occurred primarily at the washracks. In 1955, an oil/water separator (OWS, Facility 1190) was installed to recover waste materials discharged from the washracks. Non-aqueous materials from OWSs were pumped out and disposed of through contractor removal. Aqueous discharge from OWSs was pumped into the sanitary sewers.



- 1971–1975: During this period, most waste oils, spent solvents, and cleaners were disposed of by contractor removal. A private contractor would pump the materials from OWSs, 55-gallon drums, and bowers. Recovered JP-4 continued to be stored at the fire training areas and burned in practice exercises. Recovered JP-4 was also reused in AGE operations. Some waste paints (contaminated with thinners and solvents), waste oils, and PD-680 are suspected of having been disposed of in the base landfills. Some waste oils, solvents, and cleaners were discharged into sanitary sewer drains, primarily at the washracks that discharge to the Facility 1190 OWS. This OWS was routinely pumped out by a private contractor, and the recovered materials were removed from the base by the contractor.
- 1976–1982: The majority of waste oils, spent solvents, and cleaners were disposed of through services contracted either directly or through the Defense Reutilization and Marketing Office (DRMO). Recovered JP-4 was stored at the fire department training areas and burned during practice exercises. Recovered JP-4 was also used in AGE operations. PD-680 used at the washracks was discharged to the Facility 1190 OWS, which discharged to the sanitary sewers.
- 1983–Present: Waste oils, solvents, and cleaners are collected in 55-gallon drums and temporarily (less than 90 days) stored at 12 hazardous waste accumulation points located throughout the base. They are subsequently disposed of by contractor removal through DRMO. Recovered JP-4 and other fuels (mogas and unleaded gasoline) are stored at the fire department training area for subsequent burning in practice exercises or reuse in AGE operations. Waste paint solvents or thinners and strippers such as toluene, isobutyl acetate, MEK, isopropanol, naphtha, and xylene are also temporarily stored before removal. Removal of waste oils and PD-680 (Type II) from OWSs is also handled by off-base contractors through DRMO.

### 1.3 DESCRIPTION OF CURRENT STUDY

The primary area of interest for this SI, as defined by the Air Force, is located along the boundary between AFP 4 and NAS Fort Worth JRB (Figure 1-2).

The overall objective of this SI is to identify the gravel channels within the study area. The geophysical survey and soil and groundwater data collection activities that are outlined in this Work Plan are necessary to complete the following objectives:

- determination of aquitard topography,
- delineation of the gravel paleochannels above the aquitard, and
- map the groundwater plume pathway.

These primary objectives are discussed in detail in Section 3 of the Work Plan.

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## **2. SUMMARY OF EXISTING INFORMATION**

The climate, physiography, geology, hydrology, biology, and demographics of the NAS Fort Worth JRB area are described in the following sections. This data has been primarily derived from the Summary of Remediation Projects at AFP 4 Carswell AFB (Environmental Science and Engineering, Incorporated [ESE] 1994) and the Remedial Investigation/Feasibility Study (RI/FS) reports (Radian 1989a, 1991).

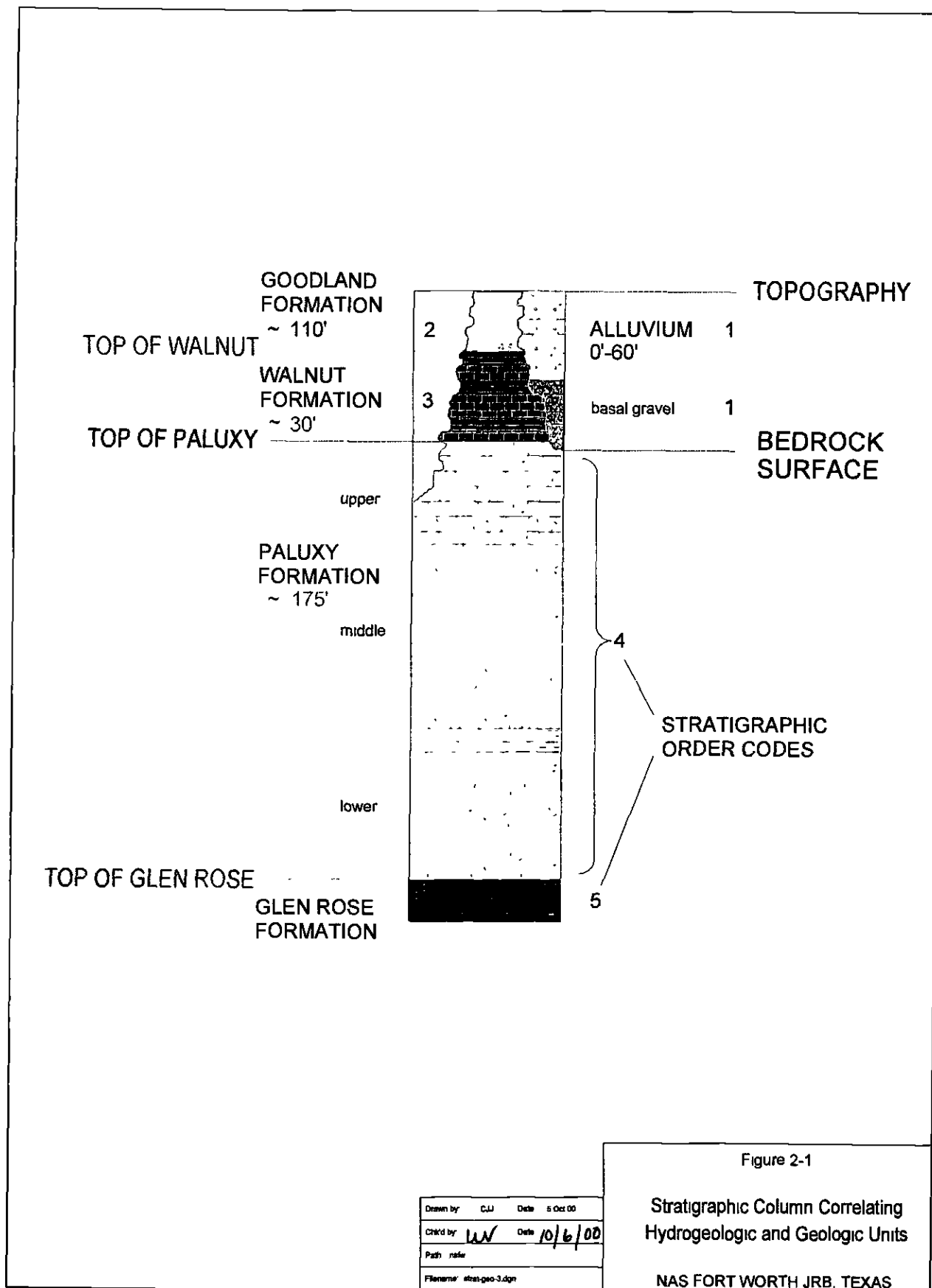
### **2.1 INSTALLATION ENVIRONMENTAL SETTING**

#### **2.1.1 Physiographic Province**

NAS Fort Worth JRB is located along the border zone between two physiographic provinces. The southeastern part of the base is situated within the Grand Prairie section of the Central Lowlands Physiographic Province. Most of NAS Fort Worth JRB is located within this province. This region is characterized by broad, eastward-sloping terrace surfaces that are interrupted by westward-facing escarpments. The land surface is typically grass covered and treeless except for isolated stands of upland timber. The northwestern part of the NAS Fort Worth JRB area is situated within the Western Cross Timbers Physiographic Province. This area is characterized by rolling topography and a heavy growth of post and blackjack oaks (Radian 1989). Surface elevations for this region range from about 850 feet above National Geodetic Vertical Datum (NGVD) west of the base to approximately 550 feet above NGVD along the eastern side of the base.

#### **2.1.2 Regional Geology**

The geologic units of interest for the region, from youngest to oldest, are as follows: (1) the Quaternary Alluvium (including fill material and terrace deposits), (2) the Cretaceous Goodland Limestone, (3) the Cretaceous Walnut Formation, (4) the Cretaceous Paluxy Formation, (5) the Cretaceous Glen Rose Formation, and (6) the Cretaceous Twin Mountains Formation. A generalized cross-section of the geology beneath NAS Fort Worth JRB is presented in Figure 2-1 (Radian 1989). The regional dip of the stratigraphic units beneath NAS Fort Worth JRB is between 35 and 40 feet per mile in an easterly to southeasterly direction. NAS Fort Worth JRB is located on the relatively stable Texas Craton, west of the faults that lie along the Ouachita Structural Belt. No major faults or fracture zones have been mapped near the base (HGL 2000c).



### 2.1.3 Groundwater

The water-bearing geologic formations located in the NAS Fort Worth JRB area may be divided into the following five hydrogeologic units, listed from the shallowest to the deepest: (1) an upper water-bearing zone occurring in the alluvial terrace deposits associated with the Trinity River, (2) an aquitard of predominantly dry limestone of the Goodland and Walnut Formations, (3) an aquifer in the Paluxy Sand, (4) an aquitard of relatively impermeable limestone in the Glen Rose Formation, and (5) a major aquifer in the sandstone of the Twin Mountains Formation. Each of these units is examined more explicitly in the following paragraphs. The relationship between these hydrogeologic units and geologic units is illustrated in Figure 2-1 (Radian 1989a).

#### 2.1.3.1 Alluvial Terrace Deposits

The uppermost groundwater in the area occurs within the pore space of the grains of coarse sand and gravels deposited by the Trinity River. In some parts of Tarrant County, primarily in those areas adjacent to the Trinity River, groundwater from the terrace deposits is used for irrigation and residential use. Groundwater from the terrace deposits is rarely used as a source of potable water due to its limited distribution and susceptibility to surface/storm water pollution (CH2M HILL 1984).

Recharge to the water-bearing deposits occurs through infiltration from precipitation and from surface water bodies. Extensive on-site pavement and construction restricts this recharge. Additional recharge, however, comes from leakage in water supply lines, sewer systems, storm drains, and cooling water systems. In 1991, this leakage was calculated to be in excess of approximately 115.5 million gallons for NAS Fort Worth JRB and AFP 4 (General Dynamics Facility Management 1992). This inflow of water to the shallow aquifer effects local groundwater flow patterns and contaminant transport, along with increasing hydraulic head, which acts as the force to potentially drive water into lower aquifer systems. The estimated hydraulic conductivity of the alluvial aquifer is 4.57 gallons per day per square foot (gpd/ft<sup>2</sup>, Radian 1989).

The groundwater flow between the Alluvial Terrace and Paluxy Aquifers is restricted by the Goodland/Walnut Formations; therefore, the alluvial terrace groundwater is not hydraulically connected to the underlying aquifers at NAS Fort Worth JRB. The primary water flow in the terrace deposits is generally eastward toward the West Fork of the Trinity River, although localized variations exist across the entire site. The hydraulic gradient across the base is variable, reflecting variations in the flow direction and localized recharge. Discharge from the aquifer occurs into on-site surface water, specifically Farmers Branch Creek (HGL 2000c).

### 2.1.3.2 Goodland/Walnut Aquitard

The groundwater within the terrace deposits is isolated from groundwater within the lower aquifers by the low permeability of the Goodland Limestone and Walnut Formations. The primary inhibitors to vertical groundwater movement within these units are the fine-grained clay and shale layers that are interbedded with layers of limestone. Some groundwater movement does occur between the individual bedding planes of both of these units, but the vertical hydraulic conductivity has been calculated to range between  $1.2\text{E-}09$  centimeters per second (cm/sec) to  $7.3\text{E-}11$  cm/sec for the NAS Fort Worth JRB and AFP 4 area. This corresponds to a vertical flow rate that ranges between  $1.16\text{E-}03$  feet per day (ft/d) to  $5.22\text{E-}03$  ft/d (ESE 1994).

In an area of AFP 4, known as the "window area", the Goodland/Walnut Aquitard is breached, allowing direct contact between the alluvial terrace groundwater and the groundwater in the Paluxy Aquifer. Several wells and borings have been advanced at NAS Fort Worth JRB to the Goodland/Walnut Aquitard. There is no evidence that similar groundwater contact exists on the NAS Fort Worth JRB base property (HGL 2000c).

### 2.1.3.3 Paluxy Aquifer

The Paluxy Aquifer is an important source of potable groundwater for the Fort Worth area. Many of the surrounding communities, particularly White Settlement, obtain their municipal water supplies from the Paluxy Aquifer. Groundwater from the Paluxy is also used by some of the surrounding farms and ranches for agricultural purposes. Due to the extensive use of the Paluxy Aquifer, water levels have declined significantly over the years. Water levels in the NAS Fort Worth JRB vicinity have not decreased as much as in the Fort Worth area due to proximity to the Lake Worth recharge area and the fact that the base does not obtain water from the Paluxy Aquifer. Drinking water at the base is supplied by the city of Fort Worth, which uses Lake Worth among its water sources. The groundwater of the Paluxy Aquifer is contained within the openings created by gaps between bedding planes, cracks, and fissures in the sandstones of the Paluxy Formation. Just as the Paluxy Formation is divided into upper and lower sand members, the aquifer is likewise divided into upper and lower aquifers. The upper sand is finer grained and contains a higher percentage of shale than the lower sand. In 1989, the hydraulic conductivity and transmissivity was estimated to be 130 to 140 gpd/ft<sup>2</sup> and 1,263 to 13,808 gpd/ft<sup>2</sup>, respectively (Radian 1989).

### 2.1.3.4 Glen Rose Aquitard

Below the Paluxy Aquifer are the fine-grained limestone, shale, marl, and sandstone beds of the Glen Rose Formation. The thickness of the formation ranges from 250 to 450 feet. Although the sands in the Glen Rose Formation yield small quantities of groundwater in the area, the relatively impermeable limestone acts as an aquitard, restricting water movement between the Paluxy Aquifer above and the Twin Mountains Aquifer below (HGL 2000c).

### 2.1.3.5 Twin Mountains Aquifer

The Twin Mountains Formation is the oldest and deepest water supply source used in the NAS Fort Worth JRB area. The Twin Mountains Formation occurs approximately 600 feet below NAS Fort Worth JRB, with a thickness of between 250 to 430 feet. Recharge to the Twin Mountains Aquifer occurs west of NAS Fort Worth JRB, where the formation outcrops. Groundwater movement is eastward in the downdip direction. The Twin Mountains groundwater occurs under unconfined conditions in the recharge area and becomes confined as it moves downdip. Transmissivities in the Twin Mountains Aquifer range from 1,950 to 29,700 gpd/ft<sup>2</sup> and average 8,450 gpd/ft<sup>2</sup> in Tarrant County. Permeabilities range from 8 to 165 gpd/ft<sup>2</sup> and average 68 gpd/ft<sup>2</sup> in Tarrant County (CH2M HILL 1984).

### 2.1.4 Surface Water

The topography of NAS Fort Worth JRB is fairly flat except for the lower lying areas along the tributaries of the Trinity River. The land surface slopes gently northeastward toward Lake Worth and eastward toward the West Fork of the Trinity River. Surface elevations range from about 690 feet above NGVD at the southwest corner of the base to approximately 550 feet above NGVD, along the eastern side of the base.

NAS Fort Worth JRB is located within the Trinity River Basin, adjacent to Lake Worth. The lake is a reservoir created by damming the Trinity River at a point just northeast of the base. The surface area of the lake is approximately 2,500 acres. Lake Worth receives a limited amount of storm water runoff from NAS Fort Worth JRB during and immediately after rainfall events. Elevation of the water surface is fairly consistent at approximately 594 feet above NGVD, the fixed elevation of the dam spillway. Part of the eastern boundary of NAS Fort Worth JRB is defined by the West Fork of the Trinity River. River flow is towards the southeast into the Gulf of Mexico. Because the Trinity River has been dammed, the 100- and 500-year flood plains do not extend more than 400 feet from the center of the river or any of its tributaries.

Surface drainage is mainly east towards the West Fork of the Trinity River. The base is partly drained by Farmers Branch Creek, a tributary of the West Fork of the Trinity River. Farmers Branch Creek begins within the community of White Settlement and flows eastward. Just south of AFP 4, Farmers Branch Creek flows under the runway within two large culverts commonly referred to as the "aqueduct." Most of the base surface runoff is intercepted by a series of storm drains and culverts, directed to OWSs, and discharged to the West Fork of the Trinity River downstream of Lake Worth. A small portion of the north end of the base drains directly into Lake Worth.

NAS Fort Worth JRB currently has three storm water discharge points that are subject to National Pollution Discharge Elimination System requirements. Each discharge point is monitored weekly for chemical oxygen demand, oil and grease, and pH. Permit limits have been violated on numerous occasions. In 1979, these violations prompted the USEPA to formally demand a corrective action (CH2M HILL 1984). Several additional

sampling points were established to determine the flow of pollutants onto and off of the base. Samples were collected for a variety of reasons (spills, fish kills, odors, and oil sheen) and parameters as circumstances dictated (Radian 1989a, b).

### 2.1.5 Air

The climate in the Fort Worth area is classified as humid subtropical with hot summers and dry winters. Tropical maritime air masses control the weather during much of the year, but the passage of polar cold fronts and continental air masses can create large variations in winter temperatures. The average annual temperature in the area is 66 degrees Fahrenheit (°F) and monthly mean temperatures vary from 45°F in January to 86°F in July. The average daily minimum temperature in January is 35°F, and the lowest recorded temperature is 2°F. The average daily maximum temperature in July and August is 95°F, and the highest temperature ever recorded at the base was 111°F. Freezing temperatures occur at NAS Fort Worth JRB on an average of 33 days per year (TNRCC 1996d).

Mean annual precipitation recorded at the base is approximately 32 inches. The wettest months are April and May, with a secondary maximum in September. The period from November to March is generally dry, with a secondary minimum in August. Snowfall accounts for a small percentage of the total precipitation between November and March. Thunderstorm activity occurs at the base an average of 45 days per year, with the majority of the activity between April and June. Hail may fall 2 to 3 days per year. The maximum precipitation ever recorded in a 24-hour period is 5.9 inches. On the average, measurable snowfall occurs 2 days per year (TNRCC 1996d).

Lake evaporation near NAS Fort Worth JRB is estimated to be approximately 57 inches per year. Evapotranspiration over land areas may be greater or less than lake evaporation depending on vegetative cover type and moisture availability. Average net precipitation is expected to be equal to the difference between average total precipitation and average lake evaporation, or approximately minus 25 inches per year. Mean cloud cover averages 50 percent at NAS Fort Worth JRB, with clear weather occurring frequently during the year. Some fog is present an average of 83 days per year. Wind speed averages 7 knots; however, a maximum of 80 knots has been recorded. Predominant wind direction is from the south-southwest throughout the year (TNRCC 1996d).

Air quality in the Dallas-Fort Worth area meets USEPA National Ambient Air Quality Standards for carbon monoxide, nitrogen dioxide, sulfur dioxide, and respirable particulate matter. However, ozone levels exceed national standards, and the ozone pollution level in the area has a Federal classification of moderate. During 1996, ozone measurements showed an arithmetic mean concentration of 0.033 parts per million in North Tarrant County. Actual exceedances of the national standards for ozone concentrations was calculated to be 2 days for the measurement station in North Tarrant County. Additional control measures are being implemented as a result of 1990 Federal Clean Air Act mandates to bring the area into compliance with the national standard (TNRCC 1996d).



### **2.1.6 Biology**

Approximately 374 acres, or 14 percent, of NAS Fort Worth JRB is considered unimproved, indicating the presence of seminatural to natural biological/ecological conditions. The base lies in the Cross Timbers and Prairies Regions of Texas, where native vegetation is characterized by alternating bands of prairies and woodlands. The higher elevations on the base are covered by native and cultivated grasses such as little bluestem, Indian grass, big bluestem, side oats, grama, and buffalo grass. Forested areas occur primarily on the lower land and along the banks of streams. Common wood species include oak, elm, pecan, hackberry, and sumac. Several non-native species such as catalpa and chinaberry are common (Radian 1989).

Typical wildlife on the base includes black-tailed jackrabbits in grassy areas along the runway. In addition, there are cotton-tail rabbits, gray squirrels, and opossums in the wooded areas. Common birds include mourning doves, meadowlarks, grackles, and starlings. Hunting and trapping are not allowed on the base, but in the nearby rural areas, they are a very popular form of recreation (Radian 1989).

Reported game fish include black bass, sunfish, and catfish, all of which can be found in Lake Worth, Farmers Branch Creek, and one small pond located on base near the golf course equipment shed. According to the Texas Department of Parks and Wildlife and the U.S. Fish and Wildlife Service, there are no threatened or endangered species known to occur on NAS Fort Worth JRB. None of the federally listed endangered plant species for Texas is known to occur within 100 miles of Tarrant County. Of the federally-listed endangered animals species, only the peregrine falcon and the whooping crane are known to occasionally inhabit the area; however, none of these is suspected to reside in the vicinity of NAS Fort Worth JRB (Radian 1989).

### **2.1.7 Demographics**

The following sections describe the regional and site-specific demographics as they relate to the Fort Worth, Texas, area, and NAS Fort Worth JRB.

#### **2.1.7.1 Regional Demographics**

Approximately 1,278,606 people reside within Tarrant County, Texas (U.S. Department of Commerce 1996). Of this population, 485,650 reside within the city limits of Fort Worth. Several smaller cities and villages make up the remainder of the population. The communities of White Settlement, Lake Worth, Westworth Village, River Oaks, and Sansom Park lie within a 3-mile radius of NAS Fort Worth JRB. The following populations that reside in the cities and villages are based on 1994 census data: White Settlement (city) - 16,502, Lake Worth (city) - 4,694, Westworth Village (town) - 2,502, River Oaks (city) - 6,747, and Sansom Park (city) - 4,136 (U.S. Department of Commerce 1994). Six schools are within a 2-mile radius of NAS Fort Worth JRB; the closest is 0.5 miles south (Rust Geotech [Rust] 1995).

The area surrounding NAS Fort Worth JRB is highly urbanized due to its proximity to the city of Fort Worth. The area is comprised of a combination of residential, commercial, and light industrial properties that employ the majority of local residents (Rust 1995).

#### **2.1.7.2 Site-Specific Demographics**

The current full-time population at NAS Fort Worth JRB is approximately 3,600 people, comprising 400 officers, 1,400 civilians, and 1,800 active reservists. Part-time military reservists will increase this population to over 6,000 military personnel (CH2M HILL 1997).

Approximately 86 percent of NAS Fort Worth JRB has been developed by way of buildings, roads, parking lots, runways, and housing and recreational areas. On-site activities include various maintenance, inspection, and support activities for fuel systems, weapons, jet engines, AGE, and specialized ground equipment (HGL 1997).

## **2.2 SITE-SPECIFIC ENVIRONMENTAL SETTING**

The following sections describe the site-specific environmental conditions in and around the AOC 20 area.

### **2.2.1 Site-Specific Geology**

The majority of NAS Fort Worth JRB is covered by alluvium deposited by the Trinity River during flood stages. The alluvium is composed of gravel, sand, silt, and clay of varying thicknesses and lateral extent. The thickness of these materials ranges from 0 to 60 feet. Fill material is also included within these deposits where landfills, waste pits, excavation sites, and other construction activities have altered the original land surface. This fill material is made up of clay, silt, sand, and gravel mixtures, but may also contain debris and other waste (Radian 1989). Paleochannels, created by the ancestral Trinity River, are present within the alluvial sediments underlying AFP 4 and the former Carswell AFB. These paleochannels are typical of erosional surfaces modified by fluvial processes and are filled with sand and gravel deposits ranging in thickness from 15 to 35 feet (CH2M HILL 1996b, HGL 2000a). The sediments within these paleochannels are more transmissive than the surrounding sediments; consequently, they provide preferential flow pathways for the migration of contaminants.

Below the alluvial terrace deposits are the Cretaceous-age Goodland and Walnut Formations, which form the bedrock surface beneath NAS Fort Worth JRB. Both formations consist of interbedded, fossiliferous, hard limestone and calcareous shale. The upper formation, the Goodland Limestone, is exposed on the southern portion of the base, south of White Settlement Road. The Goodland is a chalky-white, fossiliferous limestone and marl. The thickness of the Goodland Limestone ranges

from 20 to 25 feet. Below the Goodland Formation is the Walnut Formation (or Walnut Clay). The Walnut Formation is exposed in a small area along the shores of Lake Worth and Meandering Road Creek. This formation is a shell conglomerate limestone with varying amounts of clay and shale. It ranges in thickness from 25 to 35 feet throughout the site except where erosion has produced a few thinner areas. Subsurface investigations have located troughs that have been eroded into the top of the bedrock at NAS Fort Worth JRB. These troughs correspond to the paleochannels in the overlying alluvial sediments, which were created by the ancestral Trinity River (HGL 2000c).

Below the Walnut Formation is the Paluxy Formation (or Paluxy Sand). The Paluxy Formation underlies all of NAS Fort Worth JRB. The formation consists of several thick sandstone layers that are separated by thin, discontinuous shale and claystone layers. Sandstones in the formation are primarily a fine- to coarse-grained sand with minor amounts of clay, sandy clay, pyrite, lignite, and shale. The lower section of the Paluxy is generally coarser-grained than the upper section (CH2M HILL 1996b). Total formation thickness ranges from 130 to 175 feet, with variable thickness and occurrence of individual layers across the site. Only one unit in this formation, a shale/silty shale, can be extensively mapped across the base.

### **2.2.2 Groundwater Contamination**

AFP 4 was placed on the NPL in August 1990 because of a large release of TCE into the groundwater arising from past operational practices at AFP 4. While the source area is currently being remediated, the plume migration path is to the east of AFP 4 and extends under NAS Fort Worth JRB oriented along paleochannels. These paleochannels act as preferred pathways for groundwater flow and subsequent contaminant migration. The paleochannel that is assumed to serve as a preferential pathway for the southern lobe crosses the flightline and landfill areas of NAS Fort Worth JRB before turning east along White Settlement Road. The location of the paleochannel is based primarily on soil boring logs and logged depths to bedrock.

Previous field activities conducted to further define the southern lobe of the basewide TCE plume were completed in three stages: (1) initial screening investigation, (2) well installation and lithological investigation, and (3) three bimonthly groundwater sampling events of the newly installed wells and two bimonthly sampling rounds of active recovery wells (HGL 2000a). In addition, quarterly groundwater monitoring activities were performed basewide during the same period. The results of these investigations further refined the nature and extent of volatile organic compound (VOC) contamination within the former Carswell AFB.

Based on the recent field investigations completed within the former Carswell AFB and historical investigations conducted at AFP 4, the highest TCE concentrations in groundwater occur within AFP 4. In this area, TCE concentrations exceed 20,000 micrograms per liter ( $\mu\text{g/L}$ ) near identified source areas. Within the AOC 20 area, TCE concentrations range from 680  $\mu\text{g/L}$  at the NAS Fort Worth JRB property boundary

to nondetectable levels along the southeastern boundary of the plume. The TCE concentrations exceed the federal maximum contaminant level (MCL) of 5 µg/L for public drinking water and must be remediated prior to leaving Federal property in accordance with the AFP 4 ROD. The PRB planned for installation near AOC 20 is one component of the overall groundwater remediation program (HGL 2000c).

### 2.2.3 Surface Water Contamination

Farmers Branch Creek is the primary surface water drainage system in the central and southern portions of NAS Fort Worth JRB. It flows in an easterly direction through the base and converges with the West Fork Trinity River approximately 1.5 miles after exiting NAS Fort Worth JRB property. An underground aqueduct, approximately 2,800 feet in length and oriented in an west-east direction, diverts surface water from the former riverbed of Farmers Branch Creek under and through the NAS Fort Worth JRB flightline area. This aqueduct bisects the southern lobe of the regional TCE plume into two distinct northern and southern sub-lobes (HGL 2000c).

Historically, TCE has not been detected in surface water sampled in the western "upstream" section of the aqueduct; however, TCE has been detected in the eastern "downstream" section of the aqueduct. Clearly, TCE contamination is entering the aqueduct somewhere along its reach. It should be noted that the aqueduct crosses the paleochannel containing the regional TCE plume near Taxiway Foxtrot. Because the aqueduct intersects the saturated area of the flightline in many places, it is possible that groundwater containing TCE may be entering the aqueduct through cracks in the structure. It is also possible that the TCE may be entering the aqueduct through underground drainage systems connecting AFP 4 and NAS Fort Worth JRB to the aqueduct (HGL 2000c). An assessment of the aqueduct integrity is currently on-going.

Concentrations of TCE in surface water sampled in 1997 range from 27 J µg/L at UHGLTA001-09, located at the eastern end of the aqueduct, to a high of 61 µg/L at UHGLTA006-04, which is located just downstream of an unnamed tributary of Farmers Branch Creek. This unnamed tributary drains surface water from the southern portion of the NAS Fort Worth JRB flightline area. It is intermittent in its uppermost reaches; however, along the stretch parallel to White Settlement Road, a steady flow of water appears as the tributary cuts sharply to the north to converge with Farmers Branch Creek (HGL 1997).

Surface water samples collected from the tributary revealed TCE concentrations of 180 µg/L UHGLTA010-01 to the north and 200 µg/L at UHGLTA017-02 to the south of White Settlement Road. White Settlement Road parallels the axis of the southern lobe of the regional TCE plume. Springs and seeps draining groundwater from the regional TCE plume are the most likely source of the TCE detected in surface water samples collected from the unnamed tributary (HGL 1997). An ecological risk assessment of Farmers Branch Creek is currently on-going.

### **3. PROJECT TASKS**

The purpose of this investigation is to further delineate the paleochannel in the study area (Figure 3-1). The primary objectives are as follows:

- Mapping the subsurface topography of the paleochannel, which is the surface of the Goodland/Walnut Aquitard.
- Mapping the distribution of the gravelly deposits in the paleochannel.
- Mapping the groundwater plume pathway.

The following sections describe the current conceptual model, data needs to refine the conceptual model, investigation strategy, tasks, and procedures.

#### **3.1 CONCEPTUAL MODEL**

The current conceptual model holds that a paleochannel on top of the Goodland/Walnut aquitard conveys the TCE plume from AFP 4, allowing commingling of the dissolved phase plume with the TCE plume at NAS Fort Worth JRB. The paleochannel is an erosional depression on the aquitard filled by alluvial deposits. The most permeable unit in the alluvial deposits is a layer of gravel (the basal gravel) on top of the aquitard. The location of the paleochannel is shown on Figure 3-1.

#### **3.2 IDENTIFICATION OF DATA NEEDS**

Delineation of the paleochannel was based on soil boring logs and estimated using limited data points. The paleochannel is estimated at nearly 800 feet wide in the SI Area. The alluvial deposits are highly heterogeneous, ranging from clean gravel to tight clay, and the paleochannel may not be smooth and straight. To determine the groundwater plume flowpath in detail, it is necessary to (1) further refine the geometry of the paleochannel, (2) map the distribution of the basal gravel, and (3) refine the geometry of the regional TCE plume.

#### **3.3 INVESTIGATION STRATEGY**

The SI will be conducted in the following major phases:

1. A seismic survey will be conducted to determine the aquitard elevation.
2. An electrical imaging (EI) survey will be conducted to define the distribution pattern of the basal gravel.
3. Soil borings will be installed and logged to confirm seismic and electrical imaging survey results.

4. Groundwater samples will be collected and analyzed (from converted soil borings) to update the geometry of the TCE plume, provide natural attenuation information, and confirm current groundwater chemistry.
5. All collected information will be integrated to determine aquitard topography and paleochannel location, in support of PRB siting.

### 3.4 FIELD TASKS

Fieldwork was proposed based on SI data needs (Table 3-1). Details are described in the following sections.

**Table 3-1**  
**Proposed Field Tasks**

Scope	Quantity	Note
Seismic Survey	900 shot points	Preliminary spacing of 10 feet between each shot
Seismic Velocity Survey	2 locations	
EI Survey	4 2,000-foot lines, total 8,000 feet	Preliminary electrode spacing of 4 meters
Soil borings	6	Six borings, maximum 45 feet depth (each)
Monitoring wells	5	Conversion of 5 of the 6 soil borings into monitoring wells (2-inch PVC riser and screen and 2-foot sump)
Survey	37	Establishing geographical coordinates and elevations of 20 seismic survey points, 16 EI survey points, and 1 soil boring location
Survey	5	Establishing geographical coordinates and elevations of 5 monitoring wells
Groundwater sample collection	21	Collection of 1 groundwater sample from each of 12 wells, collection of 3 samples (top, middle, and bottom) from each of 3 deep wells at the center of the plume Analyses of samples for VOCs and natural attenuation parameters
Groundwater QA/QC samples	11	Collect QA/QC samples as necessary (see FSP)
Soil sample collection	6	Collection of 1 soil sample at the soil/groundwater interface Analyses of samples for VOCs and TOC
Soil QA/QC samples	8	Collect QA/QC samples as necessary (see FSP)
<b>Notes:</b>		
EI	electrical imaging	PVC polyvinyl chloride
FSP	Field Sampling Plan	VOC volatile organic compound
QA/QC	quality assurance/quality control	TOC total organic carbon

### 3.5 FIELD INVESTIGATION PROCEDURES

Before the mobilization, a few basic requirements for conducting the field activities will have to be established, which include:

- Identification badges will be obtained for contractor personnel as necessary.
- Flightline driving permits will be obtained for contractor personnel as necessary.
- The field office and primary staging area for field equipment and supplies will be located at Building 1916 and the IDW Yard.
- Equipment decontamination and waste staging area will be established.
- A site walk will be performed to familiarize personnel with any identified cultural features and subsurface utilities. A digging permit will be obtained from the NAS Fort Worth JRB site clearance contractor for all soil boring and monitoring well installations. Mobilization to the field will begin as soon as verbal approval of the Draft Work Plan is received from the HSC/PKV contracting officer, buyer, or HQ AFCEE contracting officer's representative.

#### 3.5.1 Seismic Survey

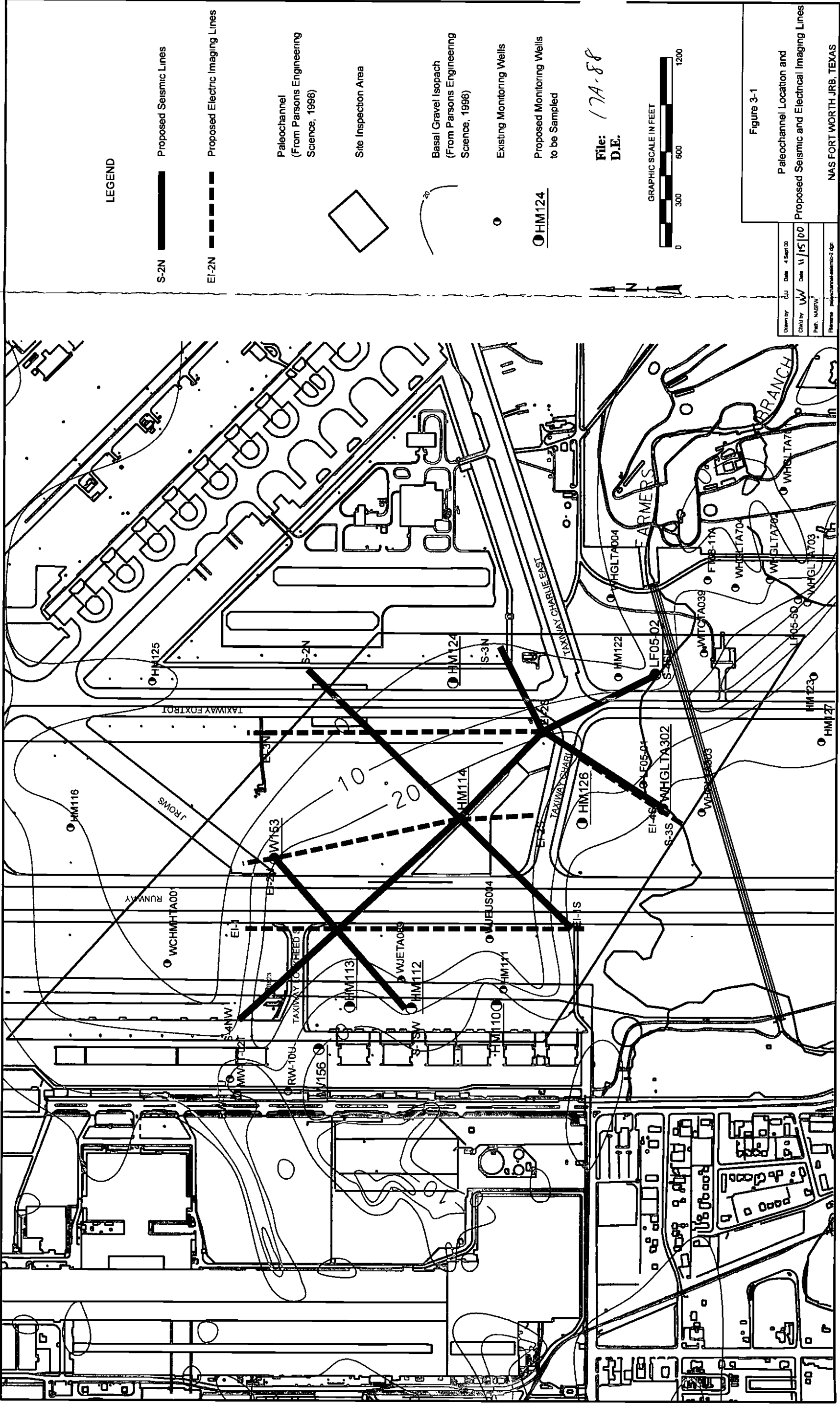
Information obtained from a previously conducted geophysical investigation in the area (Interpre'tech/SeisPulse 1998) indicates that the Goodland/Walnut aquitard is a good seismic reflector, therefore a seismic survey was selected to estimate the depth to the aquitard in the AOC 20 area. The study area includes an active runway, prohibiting the use of cables in performance of the seismic survey. Therefore, the survey will be conducted by means of the near offset seismic reflection method, which precludes the use of cable by employing a small propane canister to set off charges and a geophone at the same shot point to record the resulting seismic waves.

Existing soil boring logs record depth to the aquitard as less than 30 feet on the eastern side of the study area to 60 feet on the western side near AFP 4. Three seismic profiles are proposed nearly perpendicular to the apparent location of the paleochannel, and one proposed parallel to the paleochannel (Figure 3-1). The four profiles will consist of 900 shot points, with approximately 10 foot spacing between shot points. The survey profiles will be tied to as many existing groundwater monitoring wells, soil boring locations, and seismic data as possible to increase the accuracy of the survey. Two velocity surveys will be conducted for calibration purposes by placing a geophone in an existing groundwater monitoring well and recording the seismic velocity to each stratigraphic unit logged during monitoring well installation. Selection of the wells for the velocity survey will be based on preliminary seismic profiles and EI results.

The geographical coordinates and elevations of the seismic survey endpoints will be determined before initiation of the seismic survey to expedite data evaluation. Daily data evaluation during performance of the seismic survey will be conducted to facilitate adjustment of the seismic survey lines if necessary.

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### **3.5.2 Electrical Imaging**

An electrical imaging survey will be conducted concurrently with the seismic survey. EI measures the differences in electrical resistivity of subsurface materials. Typically, gravel units have a much higher resistivity than clays, and this difference will be used in mapping the gravel filling the paleochannel. A dipole-dipole electrode array with approximately 12 to 15 feet between electrodes will provide maximum resolution at 20 to 30 feet below ground surface. Four 2,000-foot long EI traverses perpendicular to the paleochannel are proposed (Figure 3-1). Siting of the traverses may be adjusted in the field upon evaluation of seismic survey data.

The geographical coordinates and elevations of the EI survey endpoints will be determined before initiation of the survey to expedite data evaluation. Daily data evaluation during performance of the EI survey will be conducted to facilitate adjustment of the survey lines if necessary.

EI surveys are prone to high electrode to earth contact resistance, especially in hot, dry weather. Conductive fluids will be applied to the ground surrounding the electrodes as necessary to maintain an electrode to earth resistance below 500 ohmmeters. A Schlumberger array may be substituted for the dipole-dipole array if earth to electrode resistance cannot be maintained at < 500 ohmmeters. The EI survey will be terminated if conditions for quality data collection cannot be met or maintained.

### **3.5.3 Paleochannel Confirmation**

A total of six soil borings will be installed to confirm the aquitard depth and gravel characteristics predicted by the seismic and EI surveys. Soil samples will be collected from the soil/groundwater interface. All samples will be analyzed for VOCs and total organic carbon (TOC) (Table 3-2).

### **3.5.4 Refinement of Groundwater Plume Geometry**

The paleochannel is the preferential pathway for contaminated groundwater. Five of the six soil borings will be converted to groundwater monitoring wells to provide better characterization of the contaminant plume. The wells are expected to have a depth of approximately 45 feet and penetrate two to three feet into the aquitard. Construction will consist of 2-inch diameter polyvinyl chloride (PVC) screen and riser, with a 2-foot sump. The entire length of the saturated zone will be screened. Wells will be completed with concrete pads, flush with the ground surface.

**Table 3-2**  
**Sample Quantities, Laboratory Analytical Parameters, and Methods**  
**NAS Fort Worth JRB, Texas**

Parameter/Method	Matrix	Number of Samples	QA/QC Samples	Container	Preservative	Holding Time
VOCs (USEPA SW-846 Method 8260A)	soil	6	8	3 pre-tered, 40-ml glass vials with stir bars and Teflon-lined septa	cool to 4°C	14 days (frozen)
Total Organic Carbon (USEPA Solid Waste [SW]-846 Method 9060)	soil	6	8	4-oz. glass jar	cool to 4°C	28 days
VOCs (USEPA SW-846 Method 8260A)	water	21	11	3 X 40-ml glass vials with Teflon-lined septa	HCl to pH<2, cool to 4°C	14 days
Total Suspended Solids (USEPA SW-846 Method E160.2)	water	21	11	100-ml plastic/glass bottle	cool to 4°C	7 days
Arsenic (USEPA SW-846 Method 7060A)	water	21	11	100-ml plastic/glass bottle	HNO <sub>3</sub> <2 pH	180 days
Chloride (USEPA SW-846 Method 9056)	water	21	11	250-ml glass/plastic bottle	cool to 4°C	28 days
Methane, ethane, ethene Campbell et. al., 1989 and 1998 headspace analysis	water	21	11	3 X 50-ml glass /plastic container with Teflon-lined septa and crimp caps	H <sub>2</sub> SO <sub>4</sub> <2 pH cool to 4°C	28 days
Nitrate (USEPA SW-846 Method 9056)	water	21	11	250-ml glass/plastic container	H <sub>2</sub> SO <sub>4</sub> <2 pH cool to 4°C	28 days
Sulfate (USEPA SW-846 Method 9056)	water	21	11	250-ml glass/plastic container	cool to 4°C	28 days
Alkalinity (Standard Methods Method 2320)	water	21	11	100-ml glass container	cool to 4°C	14 days
Ammonia (E350.1 or E350.3)	water	21	11	100-ml glass/plastic container	cool to 4°C	28 days
Total Organic Carbon (USEPA SW-846 Method 9060)	water	21	11	250-ml glass/plastic container	cool to 4°C	28 days
Field Parameters	pH, dissolved oxygen, redox potential, conductivity, and temperature will be taken measured using a Horiba U-22 water quality meter and ferrous iron (Fe <sup>2+</sup> ) field analysis will be performed using a colorimetric method (Hach kit #26672-00)					

Groundwater samples will be collected from the five newly installed wells as well as ten existing wells (HM-110, HM-113, HM-114, HM-122, HM-124, HM-126, W-153, W-156, WHGLTA302, and WITCUS001, Figure 3-1). Well W-153 was the only one of these wells sampled in the April 2000 sampling event (HGL 2000). Multiple groundwater samples (top, middle, and bottom) will be collected from the three deepest wells in the central portion of the plume to determine vertical stratification (if any) of the plume. Groundwater samples will be analyzed for VOCs and geochemical indicators of natural attenuation potential (Table 3-2).

### 3.5.5 Survey

To properly integrate field data, all field points will be located according to the Texas State Plane Coordinate System North Central Zone. Specifically, locations will be surveyed to a common horizontal system (North American Datum of 1983) and elevations to a common vertical datum (NGVD, equivalent of mean sea level). Field points to be surveyed include endpoints, turning points, and intersections of seismic and EI lines, soil borings, and monitoring wells. All surveying will be completed to a vertical accuracy to 0.01 feet of elevation and a horizontal accuracy of one foot for monitoring wells, and 0.1 feet of elevation and a horizontal accuracy of one foot for soil borings and geophysical survey points.

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## 4. DATA ASSESSMENT, RECORDS, AND REPORTING REQUIREMENTS

The following sections provide an explanation for procedures that are used in the verification and maintenance of data, and how data will be reported throughout the course of the investigation.

### 4.1 DATA ASSESSMENT

The project chemist will review all data received from the laboratory. This review consists of the following:

- **Sample Analysis Completeness** - Were all samples analyzed? Were samples analyzed for the parameters listed in the work plans?
- **Evaluation of Holding Times** - Were samples analyzed within the specified holding and extraction times?
- **Evaluation of QC** - Were standard curves within method control limits? Were preparation and method blanks contaminated? Were continuing calibration standards in control? Were matrix spikes (MS) and matrix spike duplicates (MSD) performed? How did field duplicates compare? Were corrective actions taken?
- **Establishment of Detection Limits** - Were detection limits met? If not, why?

The project chemist utilizes *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis* (USEPA 1988) and *National Functional Guidelines for Organic Data Review* (USEPA 1991c) as guidance documents for data validation.

In general, for the gas chromatograph (GC), an initial 5-point calibration must exhibit a response factor of less than 20 percent relative standard deviation or a calibration curve with a correlation coefficient of greater than 0.995, and the continuing calibration check standard should not vary over 15 percent of the initial calibration. Retention time windows must be established for each specific GC column initially, followed by daily retention time windows. QC check standards must be analyzed for every analytical batch, method blanks for every analytical batch, and an MS and MSD pair for every 20 samples. Surrogates must be added to all standards, blanks, and samples.

If any data points are qualified, they will receive the data qualifiers described on Table 8.2-1 of the *Base-Wide Quality Assurance Project Plan* (HGL 2000). The data associated with compounds/analytes that exhibit either poor response, poor percent difference, or relative percent difference in the initial calibration or continuing calibration standards, or poor recoveries in the laboratory control sample are considered quantitative estimates and are flagged (J, UJ, or R) accordingly. If the internal standard (IS) or

surrogate fails criteria (after corrective action was taken), compounds associated with the IS or surrogates would be flagged (J, UJ, or R) as estimated. If sample analysis exceeded holding times, the data would be flagged as estimated (J, UJ, or R). If the method blank was contaminated with common laboratory chemicals or field contamination, any result less than or equal to 10 times that found in the blank would be flagged as estimated (U) (for common organics, less than or equal to 5 times for uncommon organics and for any inorganics). When data exhibit several deficiencies resulting in poor quality assurance and QC support, then the data is rejected, considered unusable, and flagged with an "R." Any MS/MSD data would be reviewed separately and qualified based on all the data available. Estimated data is not necessarily unusable data. All project-wide precision, accuracy, and completeness goals will be reviewed, and the data will be validated according to these goals. If these goals are not met, resampling and analysis may be necessary.

The project chemist also reviews the field and office sampling records made during sample collection along with the results from the field QC samples. This review consists of the following:

- **Field Record Completeness:** Were all field analyses performed as planned? Were all field samples collected as directed in the work plans? Were any problems encountered and how were they resolved? Were all field records complete?
- **Sampling and Decontamination Procedures Review:** Were all field duplicates collected? How did they compare? Were all rinsates collected? Did these rinsates show contamination? Were the trip blanks contaminated? Did samples arrive intact and in proper shipping protocol?
- **Identification of Valid Samples:** Were samples collected using the proper protocol? Were there probable sources of potential contamination during sampling?
- **Correlation of Field Test Data and Identification of Anomalous Field Test Data:** Did different methods of measurement for the same test correlate?

Review of the results of the field QC data such as rinsates, trip blanks, and duplicates can help in assessing sample integrity. The field data and laboratory data will be reviewed and evaluated to the established data quality objectives. Data quality evaluations will be performed on all NAS Fort Worth JRB samples (100 percent). However, formal data validation will only be conducted on 10 percent of the samples collected from each media of concern during this investigation.



## **4.2 RECORD KEEPING**

Records of field and laboratory activities will be documented on standard forms (Attachment B of FSP) as noted in the accompanying FSP. Project data such as geophysical surveys, groundwater level measurements, boring logs, survey data, well construction forms, chain-of-custody forms, and equipment calibration logs will be reviewed for accuracy and completeness. These documents will be reviewed by the Project Manager daily and retained in the project files.

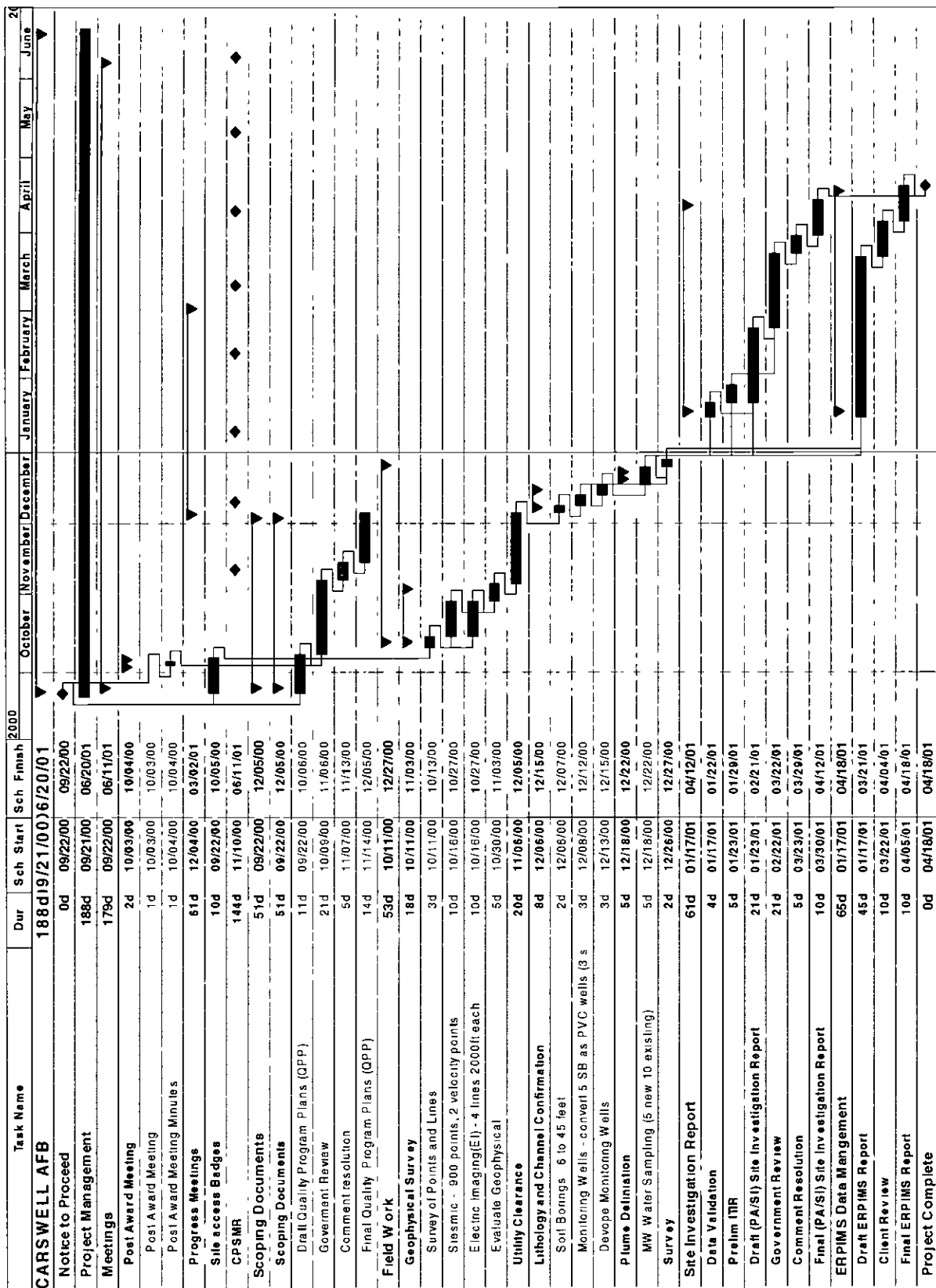
## **4.3 REPORTING REQUIREMENTS**

A draft Informal Technical Information Report (ITIR) will be completed after all data gap activities identified in this Work Plan are accomplished. The information gathered during the data gap activities will be used to complete the SI for AOC 20.

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## **5. PROJECT SCHEDULE**

The activities described in this Work Plan will be implemented in accordance with the schedule provided in Figure 5-1. The starting date for the field effort will be the date of agency concurrence of the Work Plan. If possible, this schedule will be accelerated with select activities (e.g., procurement of materials and supplies) occurring when resolution of technical issues, if any, is accomplished between NAS Fort Worth JRB and HQ AFCEE personnel.

Figure 5-1  
Project Schedule

## 6. REFERENCES

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- U.S. Environmental Protection Agency. 1991. *National Functional Guidelines for Organic Data Review*.

**APPENDIX**  
**FIELD DATA SHEETS**

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SAIC An Employee-Owned Company		WELL/SOIL BORING LOG				Plan		
Contract/DD#:		Site ID:		Location ID:				
Loc. Class Code: BH/WL	Loc. Prox. Code: I/D	Northing:		Easting:				
Ground Surface Elevation:		Estab. Co.: SAIC		Drilling Comp./Excav. Co.				
Construction Method:		Borehole Depth:	Borehole Diameter:	Location Description:				
Logged By:		Logging Company: SAIC		Log/Estab. Date:	Start Time:	Finish Time:		
Depth Below Surface (ft)	Sample						Soil Description Major constituent, Minor constituent, Color, Density, Moisture content	Comments
	Interval Type & Number	Feet Driven	Feet Recovered	DVA (ppm)	Blow Count /6"	Lithology Code		
5								
10								
15								
20								
25								
30								
35								
40								
45								

Checked By: \_\_\_\_\_ Date: \_\_\_\_\_

Revision Number: 6 Revision Date: 21 Mar 98 File Name: boringfield.DGN

**Figure WP-1**  
**Monitor Well/Soil Boring Log**



Project Name: \_\_\_\_\_

Project Manager \_\_\_\_\_

**GROUNDWATER SAMPLE COLLECTION LOG**

Site I.D.: \_\_\_\_\_ Site Name \_\_\_\_\_ Location Proximity Code I / O

Location I.D.: \_\_\_\_\_ Northing\* \_\_\_\_\_ Easting\* \_\_\_\_\_

Loc. Class. Code \_\_\_\_\_ Elevation\* \_\_\_\_\_ Date Est \* \_\_\_\_\_

Establishing Co.\* \_\_\_\_\_ Drilling Co \* \_\_\_\_\_

Excavation Co \* \_\_\_\_\_ Constr. Method.\*: HS

Location Description \_\_\_\_\_ Logging Company: \_\_\_\_\_

1 Well Depth \_\_\_\_\_ ft below top of casing (TOC)

*(Sounding/Borehole Depth)*

2 Casing Diameter\* \_\_\_\_\_ inches

3. Water level \_\_\_\_\_ ft below TOC

4. Measurement Type Static / Dynamic / Dry

If Dynamic: Production Rate \_\_\_\_\_ GPM Pump Depth \_\_\_\_\_ ft

Recovery Depth \_\_\_\_\_ ft Recovery Time \_\_\_\_\_

5. H = Height of water in well (line 1 -line 3 ) \_\_\_\_\_ ft

6a. TWO INCH WELL One Casing Volume [H x 0.163] \_\_\_\_\_ gallons

6b. FOUR INCH WELL One Casing Volume [H x 0.653] \_\_\_\_\_ gallons

6c. SIX INCH WELL One Casing Volume [H x 0.1469] \_\_\_\_\_ gallons

Purging Method \_\_\_\_\_ Sampling Method \_\_\_\_\_

Date Collected \_\_\_\_\_ Time: \_\_\_\_\_  
*(Log Date) (Log Time)*

At least \_\_\_\_\_ casing volumes have been evacuated before sampling

\* Information is required only if the well has not been sampled previously and can be obtained from the brass tag or project manager. If the well has been sampled previously, this information is optional and complete location description with the note of foster parent.

***IRPIMS information is in bold italics***Groundwater sampling/IRPIMS form 4/98  
T:\forms\IRPIMS\GWSmpCollLog.doc

Page 1 of 2

Checked by \_\_\_\_\_ Date \_\_\_\_\_  
Revision 2, 05/5/98

**Figure WP-2**  
**Groundwater Sample Collection Log (Page 1 of 2)**



Project Name: \_\_\_\_\_ Project Manager: \_\_\_\_\_

### Evacuation Stabilization Test Data

Vol Purged (gal)	Time	pH Units	Temp (°C)	Conductance (μS/cm)	Pumping Rate	Appearance

Odor/Sheen: \_\_\_\_\_ Analytical Methods: \_\_\_\_\_

Container types and volumes: \_\_\_\_\_

Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Sample ID: \_\_\_\_\_

Samples Collected By: \_\_\_\_\_

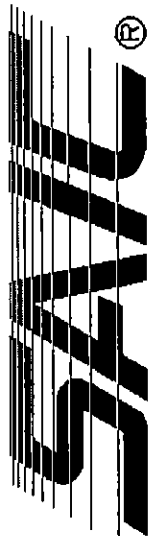
**Figure WP-2**  
**Groundwater Sample Collection Log (Page 2 of 2)**

<b>SAIC</b> <small>An Employee-Owned Company</small>		<b>WELL COMPLETION LOG</b>		Contract/DOW																																																																								
Etab. Co.: SAIC	Installed By:	Location ID:	Well Owner Code: USAF																																																																									
		Logged By:	Completion Method Code: GS																																																																									
<b>Well Construction Diagram (NTS)</b>  			Installation Date:																																																																									
			Well Type Classification Code: MW / RW / TPW																																																																									
			Geologic Completion Zone: W																																																																									
			Sole Source Aquifer Code: NCSA																																																																									
			Top of Casing Elevation (msl) (MPELEV):																																																																									
			Casing Inside Diameter:																																																																									
			Construction Material Code: PVC / SLS / PVS																																																																									
			Screen Diameter:																																																																									
			Screen Slot Size:																																																																									
			Screen Percent Open:																																																																									
Filter Pack Type:																																																																												
Filter Pack Grain Size:																																																																												
Static Depth (ft):																																																																												
Sounding (ft):																																																																												
Dry Well: Y / N																																																																												
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Lithcode</th> <th>ASTM Code</th> <th>Stratorder</th> <th>Visual Description</th> </tr> </thead> <tbody> <tr> <td>NSHA</td> <td>NSHR</td> <td>0</td> <td>No Sample/No Recovery</td> </tr> <tr> <td>FILL</td> <td>NACH</td> <td>1</td> <td>Landfill Material</td> </tr> <tr> <td>FILL</td> <td>NACH</td> <td>2</td> <td>Fill Material</td> </tr> <tr> <td>CLAY</td> <td>CH</td> <td>3</td> <td>Black Clay</td> </tr> <tr> <td>CLAY</td> <td>CH</td> <td>4</td> <td>Brown Clay</td> </tr> <tr> <td>SILT</td> <td>CL</td> <td>5</td> <td>Silt</td> </tr> <tr> <td>SO</td> <td>SC</td> <td>6</td> <td>Sand</td> </tr> <tr> <td>EWCL</td> <td>CC</td> <td>7</td> <td>Clayey Gravel</td> </tr> <tr> <td>CLAY</td> <td>CL</td> <td>8</td> <td>Loose Clay</td> </tr> <tr> <td>GVL</td> <td>GVL</td> <td>9</td> <td>Gravel</td> </tr> <tr> <td>CLAY</td> <td>CL</td> <td>10</td> <td>Heavy Transition Zone</td> </tr> <tr> <td>CLAY</td> <td>CL</td> <td>11</td> <td>Heavy Clay</td> </tr> <tr> <td>WCS</td> <td>CC</td> <td>12</td> <td>Clay</td> </tr> <tr> <td>CM</td> <td>NACH</td> <td>13</td> <td>Poured Concrete</td> </tr> <tr> <td>ASPT</td> <td>NACH</td> <td>14</td> <td>Asphalt Pavement</td> </tr> <tr> <td>STHR</td> <td>NA</td> <td>15</td> <td>Sludge</td> </tr> <tr> <td>LS</td> <td>NAHM</td> <td>16</td> <td>Rock Layer</td> </tr> </tbody> </table>					Lithcode	ASTM Code	Stratorder	Visual Description	NSHA	NSHR	0	No Sample/No Recovery	FILL	NACH	1	Landfill Material	FILL	NACH	2	Fill Material	CLAY	CH	3	Black Clay	CLAY	CH	4	Brown Clay	SILT	CL	5	Silt	SO	SC	6	Sand	EWCL	CC	7	Clayey Gravel	CLAY	CL	8	Loose Clay	GVL	GVL	9	Gravel	CLAY	CL	10	Heavy Transition Zone	CLAY	CL	11	Heavy Clay	WCS	CC	12	Clay	CM	NACH	13	Poured Concrete	ASPT	NACH	14	Asphalt Pavement	STHR	NA	15	Sludge	LS	NAHM	16	Rock Layer
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**Figure WP-3**  
**Monitoring Well Completion Form**

Checked By: \_\_\_\_\_ Date: \_\_\_\_\_

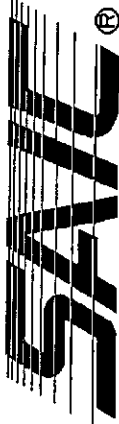
## Monitoring Well Development Form



**Science Applications  
International Corporation**  
An Employee Owned Company

[illegible]

**Figure WP-5**  
**Chain of Custody Form**



Science Applications  
International Corporation  
® An Employee Owned Company

FIELD LABORATORY TEST RESULTS

PROJECT NAME: \_\_\_\_\_  
CONTRACT NUMBER: \_\_\_\_\_  
PROJECT MANAGER: \_\_\_\_\_  
FIELD LABORATORY TECHNICIAN: \_\_\_\_\_

NAS FORT WORTH JRB PROJECT MANAGER: \_\_\_\_\_  
NAS FORT WORTH JRB IRP SITE NUMBER: \_\_\_\_\_  
FIELD TEAM LEADER: \_\_\_\_\_

Sample ID	Time		Result		Time		Result		Time		Result	
	Time	Result	Time	Result	Time	Result	Time	Result	Time	Result	Time	Result
Location ID												
Date Analyzed												
Ferrous Iron (mg/L)												
Redox Potential (mV)												
Dissolved Oxygen (mg/L)												
Turbidity (NTU)												
pH												
Temperature (°C)												
Sp. Conductivity (mS/cm)												

- NOTES:
- 1) Ferrous iron analyzed by Hach Spectrophotometer, Model DR/2000, using method 8146
  - 2) Redox Potential analyzed by Orion Portable pH/ISE Meter, Model 250A.
  - 3) Turbidity analyzed by Hach Turbidimeter, Model 2100P.
  - 4) pH, temperature, dissolved oxygen, and specific conductivity analyzed by Horiba Water Quality Checker, Model U-10

Figure WP-6  
Field Laboratory Test Results

687 62

**NAS FORT WORTH JRB PROJECT MANAGER:**

**NAS FORT WORTH JRB SITE NUMBER:**

**FIELD TEAM LEADER:**

\_\_\_\_\_

Page \_\_\_\_ of \_\_\_\_

### Figure WP-7



# TAB

Health and Safety Plan

**AOC 20 SITE INSPECTION  
NAS FORT WORTH JRB, TEXAS**

**HEALTH AND SAFETY PLAN**

**FINAL**

Prepared for  
U.S. Air Force Center for Environmental Excellence  
Brooks AFB, Texas

Prepared by  
SCIENCE APPLICATIONS INTERNATIONAL CORPORATION  
San Antonio, Texas

Contract No. F41624-00-D-8030  
Delivery Order No. 0007

November 2000

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**Appendix****Health and Safety Forms**

## ACRONYMS AND ABBREVIATIONS

AFCEE	U.S. Air Force Center for Environmental Excellence
AFP 4	Air Force Plant 4
ANSI	American National Standards Institute
AOC	Area of Concern
C	ceiling value, a 15-minute time weighted average that shall not be exceeded at any time during the workday
CFR	Code of Federal Regulations
COR	contracting officer's representative
CPC	chemical protective clothing
CPR	cardiopulmonary resuscitation
CPR	cardiopulmonary resuscitation
EI	electrical imaging
FSP	Field Sampling Plan
HAZWOPER	Hazardous Waste Site Operations
HCS	hazard communication standard
HPS	hantavirus pulmonary syndrome
HQ	Headquarters
HSO	Health and Safety Officer
HSP	Health and Safety Plan
IDLH	immediately dangerous to life and health
IDW	investigation-derived waste
LEL	lower explosive limit
MEK	methyl ethyl ketone
MSDS	Material Safety Data Sheet
NA	not applicable
NAS Fort Worth JRB	Naval Air Station Fort Worth Joint Reserve Base
ND	not determined
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PID	photoionization detector
POC	point of contact

**ACRONYMS AND ABBREVIATIONS (cont.)**

PPE	personal protective equipment
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RCO	Responsible Corporate Officer
SAIC	Science Applications International Corporation
SI	site inspection
SSO	Site Safety Officer
T	air temperature
T <sub>aj</sub>	adjusted air temperature
TCE	trichloroethene
TOC	total organic carbon
UEL	upper explosive limit
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

**Abbreviations**

°C	degrees Celsius
dB(A)	decibel A-weighted scale
eV	electron volts
°F	degrees Fahrenheit
mg/m <sup>3</sup>	milligrams per cubic meter
O <sub>2</sub>	oxygen
P.E.	Professional Engineer
PM	Project Manager
ppm	parts per million
U.S.	United States



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## 1. INTRODUCTION

### 1.1 PURPOSE

This Health and Safety Plan (HSP) is designed to assign responsibilities, establish personnel protection standards, specify mandatory operating procedures, and provide for emergency contingencies with respect to health and safety issues that may arise while Science Applications International Corporation (SAIC) personnel and subcontractor personnel are engaged in the field activities associated with paleochannel delineation at Area of Concern (AOC) 20 at the following sites (pictured in Figure 1-2 of the Work Plan):

The study area is located within the former Carswell Air Force Base or the Naval Air Station Fort Worth Joint Reserve Base (NAS Fort Worth JRB), located in Fort Worth, Texas. For purposes of data continuity, the study area includes a small strip of Air Force Plant 4 (AFP 4) property. The activities under this HSP and corresponding Work Plans were requested under the authorization of Headquarters (HQ) United States (U.S.) Air Force Center for Environmental Excellence (AFCEE) Contract Number F41624-00-D-8030, Delivery Order Number 0007.

This HSP conforms to the requirements of Occupational Safety and Health Administration (OSHA) Standard 29 Code of Federal Regulations (CFR) 1910 and 1926. Detailed OSHA requirements for hazardous waste operations are contained in OSHA Standard 29 CFR 1910.120 and OSHA Standard 29 CFR 1926.65, "Hazardous Waste Operations and Emergency Response." Additional guidance for hazardous waste operations may be found in the U. S. Environmental Protection Agency (USEPA) publication *Standard Operating Safety Guides* (June 1992), the National Institute of Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/USEPA publication *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (October 1985), and Federal Acquisition Regulation clause 52.236-13, Accident Prevention.

This HSP is based on available background information regarding possible chemical, physical, and biological hazards that may exist in the study area. If more information concerning the nature and/or concentrations of contaminants becomes available, this HSP will be amended accordingly.

### 1.2 APPLICABILITY

The provisions of the HSP are mandatory for all official visitors, SAIC employees, and subcontractors while investigations are being conducted at NAS Fort Worth JRB. These investigations will include the installation of six borings, five groundwater monitoring wells and associated soil and water sample collection. Inadequate health and safety precautions on the part of visitors or subcontractors, or the belief that personnel on the site are or may be exposed to an immediate health hazard, will be cause for SAIC to

suspend on-site activities, require all personnel to evacuate the area, and immediately notify the Contracting Officer or the Contracting Officer's Representative (COR).

### **1.3 PROJECT ORGANIZATION, PERSONNEL, AND RESPONSIBILITIES**

This section outlines SAIC's personnel organization for this project as presented in Figure 4-1 of the Field Sampling Plan (FSP) and establishes the roles and responsibilities of various project personnel regarding site health and safety. The authority and responsibilities of each SAIC individual utilized for this project are presented in the following sections.

#### **1.3.1 Responsible Corporate Officer**

The Responsible Corporate Officer (RCO) for this project will be David K. Dougherty. The RCO has authority to direct changes to the Corporate Health and Safety Program and determines and implements personnel disciplinary actions, as required. The RCO's responsibilities for this project include the following:

- Direct and monitor the implementation of the Corporate Health and Safety Program.
- Advise on health and safety matters.
- Issue directives, advisories, and information to the Health and Safety Officer (HSO).

#### **1.3.2 Health and Safety Officer**

The HSO for this project will be Michael Holdsworth. The HSO has the authority to:

- Suspend work or otherwise limit exposure to personnel if health and safety plans appear to be unsuitable or inadequate.
- Direct personnel to change work practices if existing practices are deemed hazardous to their health and safety.
- Remove personnel from projects if their actions or conditions endanger their health and safety or the health and safety of coworkers.
- Approve the qualifications of employees to work at hazardous waste sites.
- Approve health and safety plans.

The HSO responsibilities for this project will include the following:

- Interfacing with the Project Manager (PM) in matters of health and safety.
- Keeping the RCO and PM informed on the status of the site health and safety plan.
- Developing or reviewing and approving project health and safety plans prior to submittal.
- Ensuring staff training and orientation on health and safety-related activities.
- Appointing or approving the Site Safety Officer (SSO).
- Monitoring compliance with health and safety plans and conducting site audits.
- Assisting in obtaining required health and safety equipment.
- Approving personnel to work on hazardous waste management projects with regard to medical examinations and health and safety training.
- Maintaining records pertaining to medical surveillance, training, fit testing, chemical exposure, and accidents/incidents.
- Providing industrial hygiene/chemical safety guidance.

### **1.3.3 Project Manager**

The PM for work under Delivery Order 0007 will be Robert W. Bauer, Professional Engineer (P.E.) The PM has the authority to:

- Coordinate with the HSO on health and safety matters.
- Assign an HSO-approved SSO to the project and, if necessary, assign a suitably qualified replacement.
- Temporarily suspend field activities if health and safety of personnel are endangered, pending an evaluation by the HSO.
- Temporarily suspend an individual from field activities for infractions of the health and safety plan, pending an evaluation by the HSO.

The PM responsibilities for this project will include the following:

- Ensuring that the project is performed in a manner consistent with the health and safety program.
- Ensuring that the project health and safety plan is prepared, approved, and properly implemented.

- Providing the HSO with the information needed to develop health and safety plans.
- Ensuring that adequate funds are allocated to fully implement project health and safety plans.

#### 1.3.4 Site Safety Officer

The SSO will direct all on-site health and safety training and daily safety inspections. A qualified SAIC employee who has performed these functions previously will be the designated SSO. The SSO has the authority to temporarily suspend field activities if the health and safety of personnel are endangered, pending further consideration by the HSO, and to temporarily suspend an individual from field activities for infractions of the health and safety plan, pending an evaluation by the HSO.

The SSO will report any problems or concerns to the SAIC HSO and PM. The HSO will also review accident reports and air monitoring data sheets; however, because these reviews are necessarily conducted after the fact, the SSO remains the person responsible for on-site safety. At the facilities, the SSO has primary responsibility for:

- Directing health and safety activities on the site.
- Ensuring that appropriate personal protective equipment (PPE) is available and properly utilized by SAIC personnel, visitors, and subcontractor personnel.
- Ensuring that personnel are aware of the provisions of this plan, are instructed in the work practices necessary to ensure safety, and are aware of planned procedures for dealing with emergencies.
- Ensuring that personnel are aware of the potential hazards associated with investigation activities.
- Monitoring the safety performance of all personnel to ensure that required work practices are followed.
- Monitoring the physical condition of site workers for heat and cold stress.
- Correcting any work practices or conditions that may result in injury or exposure to hazardous substances.
- Ensuring the completion of the site-specific HSP forms.
- Ensuring that a copy of the HSP is maintained on the site during all investigation activities.

- Ensuring that all air monitoring and equipment calibrations required by the HSP are performed and recorded, and that logs/forms that include these activities are maintained.
- Ensuring that the subcontractor's medical monitoring program is adequate per OSHA Standard 29 CFR 1910.120 and this HSP.
- Verifying OSHA 40-hour health and safety training before admitting official site visitors (e.g., Air Force and regulatory representatives) in an exclusion zone and verifying medical certification and fit-testing for respirator use for visitors requesting admittance into a Level C PPE exclusion zone (per OSHA Standard 29 CFR 1910.120).

### **1.3.5 Project Field Personnel**

Personnel working on this project will be approved by the PM and the HSO and will meet the qualifications outlined in OSHA Standard 29 CFR 1910.120, and this HSP. The project personnel involved in on-site investigations and operations are responsible for:

- Taking all reasonable precautions to prevent injury to themselves and to their fellow employees.
- Implementing the HSP and reporting any deviations from the anticipated conditions described in the plans to the SSO.
- Performing only those tasks that they believe they can do safely, and immediately reporting any accidents and/or unsafe conditions to the SSO.

### **1.3.6 Subcontractor Responsibilities**

It is the responsibility of each SAIC subcontractor to ensure compliance with all applicable federal and state regulations, including OSHA Standard 29 CFR, Parts 1900 through 1910, and Part 1926, and the contents of this HSP. Specifically contained within these OSHA regulations is OSHA Standard 29 CFR 1910.120, which includes requirements for training and medical surveillance for employees engaged in certain hazardous waste operations.

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## **2. SITE DESCRIPTION INFORMATION .**

The primary area of interest for this site inspection (SI) consists of the southern lobe of the regional trichloroethene (TCE) plume. This area is located along the boundary between Air Force Plant 4 (AFP 4) and NAS Fort Worth JRB (Figure 1-2 of the Work Plan).

The overall objective of this SI is to identify the gravel channels within the southern lobe of the regional TCE plume. The geophysical survey and soil and groundwater data collection activities that are outlined in this Work Plan are necessary to complete the following objectives:

- determination of aquitard topography, and
- delineation of the gravel paleochannels above the aquitard.

These primary objectives are discussed in detail in Section 3 of the Work Plan.



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### **3. SITE INVESTIGATION ACTIVITIES**

The following sections present the proposed field investigation tasks.

#### **3.1 FIELD INVESTIGATION TASKS**

The proposed field tasks described in the following sections will be conducted to achieve the project objectives. The field tasks described in the following sections were selected based on the type of data needed to complete the data collection process.

The following sections provide the proposed site inspection activities. Proposed survey locations may shift due to localized site-specific conditions such as utilities, fences, and structures encountered during the field implementation.

##### **3.1.1 Mobilization**

Mobilization to the field is expected to begin as soon as relevant portions of the Work Plan are approved. Contractor photographic identification badges will be obtained for lead personnel who will escort subcontractors to and from restricted areas. The primary staging area for field equipment and supplies will be located at the investigation-derived waste (IDW) yard inside the main gate off Military Parkway.

The purpose of this investigation is to further delineate the paleochannel in the study area (Figure 3-1 of the Work Plan). The primary objectives are as follows:

- Mapping the subsurface topography of the paleochannel, which is the surface of the Goodland/Walnut Aquitard.
- Mapping the distribution of the gravelly deposits in the paleochannel.
- Mapping the groundwater plume pathway.

The following sections describe the current conceptual model, data needs to refine the conceptual model, investigation strategy, tasks, and procedures.

#### **3.2 CONCEPTUAL MODEL**

The current conceptual model holds that a paleochannel on top of the Goodland/Walnut aquitard conveys the TCE plume from AFP 4, allowing commingling of the dissolved phase plume with the TCE plume at NAS Fort Worth JRB. The paleochannel is an erosional depression on the aquitard filled by alluvial deposits. The most permeable unit in the alluvial deposits is a layer of gravel (the basal gravel) on top of the aquitard. The approximate location of the paleochannel is shown on Figure 3-1 of the Work Plan.

### **3.3 IDENTIFICATION OF DATA NEEDS**

Delineation of the paleochannel was based on soil boring logs and estimated using limited data points. The paleochannel is estimated at nearly 800 feet wide in the SI Area. The alluvial deposits are highly heterogeneous, ranging from clean gravel to tight clay, and the paleochannel may not be smooth and straight. To determine the groundwater plume flowpath in detail, it is necessary to (1) further refine the geometry of the paleochannel, (2) map the distribution of the basal gravel, and (3) refine the geometry of the regional TCE plume.

### **3.4 INVESTIGATION STRATEGY**

The SI will be conducted in the following major phases:

1. A seismic survey will be conducted to determine the aquitard elevation.
2. An electrical imaging (EI) survey will be conducted to define the distribution pattern of the basal gravel.
3. Soil borings will be installed and logged to confirm seismic and electrical imaging survey results.
4. Selected soil borings will be converted to groundwater monitoring wells to allow sampling of groundwater.
5. Groundwater samples will be collected and analyzed to determine current groundwater chemistry, update the geometry of the TCE plume, and provide natural attenuation information.
6. All collected information will be integrated to determine aquitard topography and paleochannel location, in support of permeable reactive barrier siting.

### **3.5 FIELD TASKS**

Fieldwork was proposed based on SI data needs (Table 3-1). Details are described in the following sections.

### **3.6 FIELD INVESTIGATION PROCEDURES**

Before the mobilization, a few basic requirements for conducting the field activities will have to be established, which include:

- Identification badges will be obtained for contractor personnel as necessary.
- Flightline driving permits will be obtained for contractor personnel as necessary. All personnel will take the required two hour long flightline drivers' course before receiving government-issued radios to be used on the flightline. Contractor personnel will contact flightline operations via radio to request flightline entry

permission. Radio contact will be maintained with flightline operations during all activities on the flightline, and upon exiting the flightline area, as required.

- The field office and primary staging area for field equipment and supplies will be located at Building 1916 and the IDW Yard.
- Equipment decontamination and waste staging area will be established.
- A site walk will be performed to familiarize personnel with any identified cultural features and subsurface utilities. A digging permit will be obtained from the NAS Fort Worth JRB site clearance contractor for all soil boring and monitoring well installations. Mobilization to the field will begin as soon as verbal approval of the Draft Work Plan is received from the Human Systems Center Environmental Contracting Division Contracting Officer or Buyer, or the HQ AFCEE COR.

**Table 3-1**  
**Proposed Field Tasks**

Scope	Quantity	Note
Seismic Survey	900 shot points	Preliminary spacing of 10 feet between each shot
Seismic Velocity Survey	2 locations	
EI Survey	4 2,000-foot lines, total 8,000 feet	Preliminary electrode spacing of 4 meters
Soil borings	6	Six borings, maximum 45 feet depth (each)
Monitoring wells	5	Conversion of 5 of the 6 soil borings into monitoring wells (2-inch PVC riser and screen and 2-foot sump, flush-mount concrete pad)
Survey	37	Establishing geographical coordinates and elevations of 20 seismic survey points, 16 EI survey points, and 1 soil boring location
Survey	5	Establishing geographical coordinates and elevations of 5 monitoring wells
Groundwater sample collection	21	Collection of 1 groundwater sample from each of 12 wells, collection of 3 samples (top, middle, and bottom) from each of 3 deep wells at the center of the plume Analyses of samples for VOCs and natural attenuation parameters
Groundwater QA/QC samples	11	Collect QA/QC samples as necessary (see FSP)
Soil sample collection	6	Collection of 1 soil sample at the soil/groundwater interface Analyses of samples for VOCs and TOC
Soil QA/QC samples	8	Collect QA/QC samples as necessary (see FSP)
<b>Notes:</b>		
EI	electrical imaging	QA/QC quality assurance/quality control
FSP	Field Sampling Plan	TOC total organic carbon
PVC	polyvinyl chloride	VOC volatile organic compound

### 3.6.1 Seismic Survey

Information obtained from a previously conducted geophysical investigation in the area (Interpre'tech/SeisPulse 1998) indicates that the Goodland/Walnut aquitard is a good seismic reflector, therefore a seismic survey was selected to estimate the depth to the aquitard in the AOC 20 area. The study area includes an active runway, prohibiting the use of cables in performance of the seismic survey. Therefore, the survey will be conducted by means of the near offset seismic reflection method, which precludes the use of cable by employing a small propane canister to set off charges and a geophone at the same shot point to record the resulting seismic waves.

Existing soil boring logs record depth to the aquitard as less than 30 feet on the eastern side of the study area to 60 feet on the western side near AFP 4. Three seismic profiles are proposed nearly perpendicular to the apparent location of the paleochannel, and one proposed parallel to the paleochannel (Figure 3-1 of the Work Plan). The four profiles will consist of 900 shot points, with approximately 10 foot spacing between shot points. The survey profiles will be tied to as many existing groundwater monitoring wells and soil boring locations as possible to increase the accuracy of the survey. Two velocity surveys will be conducted for calibration purposes by placing a geophone in an existing groundwater monitoring well and recording the seismic velocity to each stratigraphic unit logged during monitoring well installation. The wells selected for the velocity survey will be based on preliminary seismic profiles and EI results.

The geographical coordinates and elevations of the seismic survey endpoints will be determined before initiation of the seismic survey to expedite data evaluation. Daily data evaluation during performance of the seismic survey will be conducted to facilitate adjustment of the seismic survey lines if necessary.

## **4. HAZARD ASSESSMENT**

This section identifies and evaluates potential site hazards that may be encountered during field activities. Control measures to protect site personnel from these potential hazards are incorporated throughout this HSP, but are located primarily in the following sections:

- Section 6 - Air Monitoring
- Section 7 - Personal Protective Equipment
- Section 11 - Standard Work Practices
- Section 11.5 - Confined Space Entry

### **4.1 CHEMICAL HAZARDS**

The primary concerns from a chemical exposure standpoint are inhalation, ingestion, and absorption by direct skin contact with contaminants in locations expected to be source areas. Based upon the information obtained from previous site investigations (groundwater and soil), the primary chemicals of concern at NAS Fort Worth JRB have been identified and are listed in Table 4-1, along with their exposure limits and recognition properties. The acute and chronic symptoms of overexposure to these chemical contaminants and first aid procedures are presented in Table 4-2. If additional contaminants are identified during project activities, this HSP will be amended accordingly.

### **4.2 DECONTAMINATION SOLUTIONS AND PRESERVATIVES**

Chemicals used to decontaminate sampling equipment and to preserve environmental samples also present hazards to the project personnel who use them. The chemicals likely to be brought to the site for use in this manner include the following:

- Nitric Acid
- Hydrochloric Acid
- Sulfuric Acid
- Methanol
- Hexane
- Liquid Tide™
- Alconox™

**Table 4-1**  
**Exposure Limits and Recognition Qualities**

Compound	Permissible Exposure Limit (PEL) <sup>a</sup>	IDLH Level <sup>b</sup>	Recognition Qualities			Odor Warning Concentration (ppm)	LEL <sup>c</sup> (%)	UEL <sup>d</sup> (%)	Ionization Potential (eV)
			Color	Odor	State				
Arsenic Compounds	0.010 mg/m <sup>3</sup>	5 mg/m <sup>3</sup> <sup>e</sup>	Silver gray to tin-white	Odorless	Solid	NA	NA	NA	NA
Benzene	1.0 ppm <sup>f</sup>	500 ppm <sup>e</sup>	Colorless to light yellow	Aromatic	Liquid	1.5 - 5.0	1.2	7.8	9.24
Hexane	500 ppm	1,100 ppm	Colorless	Gasoline-like	Liquid	NA	1.1	7.5	10.18
Hydrochloric Acid	5 ppm	50 ppm	Colorless to light yellow	Irritating	Gas	NA	NA	NA	12.74
Methanol	200 ppm	6,000 ppm	Colorless	Pungent	Liquid	100	6.0	36.0	10.84
Nitric Acid	2 ppm	25 ppm	Colorless, red, or yellow	Acrid, suffocating	Liquid	NA	NA	NA	11.95
Sulfuric Acid	1 mg/m <sup>3</sup>	15 mg/m <sup>3</sup>	Colorless, yellow, or brown	Odorless	Solution	NA	NA	NA	ND
Trichloroethene	100 ppm <sup>f</sup>	1,000 ppm <sup>e</sup>	Colorless	Chloroform-like	Liquid	28.0	8.0	10.5	9.45

<sup>a</sup> OSHA permissible exposure limit or the American Conference of Governmental Industrial Hygienists' threshold limit value (both 8-hour time weighted averages)

<sup>b</sup> Immediately dangerous to life or health.

<sup>c</sup> Lower explosive limit.

<sup>d</sup> Upper explosive limit

<sup>e</sup> To be treated as a carcinogen

<sup>f</sup> The value presented is the OSHA permissible exposure level (PEL), which is not necessarily the most conservative of the available exposure limits. The air monitoring screening levels in Table 6.1 are based upon the most conservative values

C Ceiling value, a 15-minute Time Weighted Average that shall not be exceeded at any time during the workday

eV Electron volts.

IDLH immediately dangerous to life and health

LEL lower explosive level

mg/m<sup>3</sup> Milligrams per cubic meter

NA Not applicable.

ND Not determined

OSHA Occupational Safety and Health Administration

ppm Parts per million

UEL upper explosive limit

Source: National Institute for Occupational Safety and Health 1997

**Table 4-2**  
**Acute and Chronic Effects**  
**Symptoms of Overexposure and First Aid Treatment**

Compound	Symptoms of Overexposure	First Aid Treatment
Arsenic	Ulceration of nasal septum, dermatitis; gastrointestinal disturbances; peripheral neuropathy, respiratory irritation; hyperpigmentation of skin; carcinogen	Eye: Irrigate immediately (15 minutes) Skin: Soap wash immediately Inhalation: Not an inhalation hazard Ingestion: Medical attention immediately
Hexane	Light-headedness, nausea, headaches, numbness in extremities, weak muscles, eye irritation, nose irritation, dermatitis, chemical pneumonia, giddiness	Eye: Irrigate immediately Skin: Soap, wash immediately Inhalation: Respiratory support Ingestion: Medical attention immediately
Hydrochloric Acid	Inflammation of the nose, throat, laryngeal, cough, burns throat, choking; burns eyes, skin; dermatitis	Eye: Irrigate immediately Skin: Water flush immediately Inhalation: Respiratory support Ingestion: Medical attention immediately
Indeno(1,2,3-cd)pyrene	See coal tar pitch volatiles	
Methanol	Eye irritant, headache, drowsiness; lightheadedness, nausea, vomiting; visual disturbances, blindness	Eye: Irrigate immediately Skin: Water flush immediately Inhalation: Respiratory support Ingestion: Medical attention immediately
Nitric Acid	Irritation of eyes, mucous membranes, and skin, delayed pulmonary edema, pneumitis, bronchitis; dental erosion	Eye: Irrigate immediately Skin: Water flush immediately Inhalation: Respiratory support Ingestion: Medical attention immediately
Sulfuric Acid	Irritation to eyes, nose, and throat; pulmonary edema; bronchitis; emphysema, conjunctivitis; stomatitis; dental erosion; tracheobronchitis; eye and skin burns; dermatitis	Eye: Irrigate immediately Skin: Water flush immediately Inhalation: Move to fresh air; respiratory support Ingestion: Medical attention immediately
Trichloroethene	Headache, vertigo; visual disturbance, tremors, somnolence, nausea, vomiting; irritation of the eyes, dermatitis; cardiac arrhythmias, paresthesia; carcinogen	Eye: Irrigate immediately Skin: Soap wash promptly Inhalation: Respiratory support Ingestion: Medical attention immediately
Source: National Institute for Occupational Safety and Health 1997		



Although overexposure to these chemicals is unlikely, the acute and chronic symptoms and first aid procedures are also presented in Table 4-2.

In order to communicate the hazards of these chemicals to site personnel, Material Safety Data Sheets (MSDS) for each of these chemicals will be maintained on-site and presented as part of the site-specific training (Section 10.2).

### **4.3 PHYSICAL HAZARDS**

The following section titles identify physical hazards that may be encountered. They include, but are not limited to:

- Hot or Cold Work Environments (Stress)
- Noise Hazards
- Materials Handling
- Utility Hazards
- Fall, Trip, and Slip Hazards (Section 11)
- Flammable/Explosive Atmospheres (Section 6)
- Heavy Equipment/Vehicular Activity (Section 11)
- Control measures to help protect site personnel from these potential hazards are incorporated in the following subsections and throughout this HSP.

#### **4.3.1 Heat Stress**

Heat stress can be a problem, especially if personnel must perform site activities while wearing PPE in warm, humid weather conditions. The four types of heat illness in increasing order of severity include heat rash, heat cramps, heat exhaustion, and heat stroke.

1. Heat rash may result from continuous exposure to heat or humid air.
2. Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include muscle spasms and pain in the hands, feet, and abdomen.
3. Heat exhaustion occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include pale, cool, and moist skin; heavy sweating; dizziness, fainting, and nausea.

4. Heat stroke is the most serious form of heat stress. Temperature regulation fails and body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occurs. When heat stroke is suspected, professional medical help must be obtained immediately. Signs and symptoms include red, hot, and unusually dry skin; lack of or reduced perspiration; dizziness and confusion; strong, rapid pulse; and coma.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important, because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional injuries. To avoid heat stress, the following steps should be taken:

Work schedules should be adjusted. The following guidelines of rest and cooling of the body will be followed to minimize the effects of heat stress:

- If oral temperature exceeds 99.6 degrees Fahrenheit (°F) (37.6 degrees Celsius [°C]), shorten the next work cycle by one-third without changing the rest period.
- If oral temperature still exceeds 99.6 °F (37.6 °C) at the beginning of the next rest period, shorten the following work cycle by one-third.
- Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6 °F (38.1 °C).

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (See Table 4-3). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

**Table 4-3**  
**Suggested Frequency of Physiological Monitoring for**  
**Fit and Acclimatized Workers**

Adjusted Temperature <sup>1</sup>	Normal Work Ensemble <sup>2</sup>	Impermeable Ensemble
90°F or above	After each 45 minutes of work	After each 15 minutes of work
87.5°F - 90°F	After each 60 minutes of work	After each 30 minutes of work
82.5°F - 87.5°F	After each 90 minutes of work	After each 60 minutes of work
77.5°F - 82.5°F	After each 120 minutes of work	After each 90 minutes of work
72.5°F - 77.5°F	After each 150 minutes of work	After each 120 minutes of work
°F Degrees Fahrenheit Notes: <sup>1</sup> Calculate the adjusted air temperature (T <sub>aj</sub> ) by using the equation: T <sub>aj</sub> (°F) = T (°F) + (13 x % sunshine) Measure air temperature (T) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat Estimate percent sunshine by judging what percent time the sun is not covered by clouds thick enough to produce a shadow (100 percent sunshine = no cloud cover and a sharp, distinct shadow, 0 percent sunshine = no shadows) <sup>2</sup> A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants Source: National Institute of Occupational Safety and Health/OSHA/USCG/USEPA 1985		

Shelter (equipped with air conditioners and other cooling devices, if possible) or shaded areas should be provided to protect personnel during rest periods.

Workers' body fluids should be maintained at normal levels to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water perspired, which will vary from day to day. The normal thirst mechanism is not sensitive enough to ensure that water intake is sufficient to replace water lost through perspiration. When heavy sweating occurs, workers should be encouraged to drink more. Have workers drink fluid (preferably water or diluted drinks) before beginning work. Urge workers to drink a cup or two at each scheduled break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but will depend on actual fluid replacement needs, which will vary depending on the sweat rate.

- The drinking water temperature should be maintained at 50°F to 60°F (10°C to 15.6°C).
- Disposable cups that hold about 16 ounces should be provided.
- Workers should be encouraged to maintain an optimal level of physical fitness. Where indicated, acclimatize workers to site work conditions.
- Workers should be trained to recognize, identify, and treat heat stress.
- When heat stress is suspected, the following steps should be taken:
  - Move the victim out of the heat.
  - Loosen tight clothing.
  - Remove perspiration-soaked clothing.
  - Apply cool, wet cloths to the skin.
  - Fan the victim.
- If the victim is conscious, give cool water to drink. Do not give electrolyte solutions (i.e., those containing salt) to victims of heat stress because it can cause nausea and vomiting. Only small sips of cool water should be administered to heat stress victims.
- Call for an ambulance if the victim refuses water, vomits, or starts to lose consciousness.

#### 4.3.2 Cold Stress

If site work is to be conducted during the winter, cold stress is a concern to the health and safety of personnel. Special concern must be taken with regard to the wearing of

Tyvek™ suits in cold weather. Such disposable clothing does not “breathe,” perspiration does not evaporate, and the suits can become wet. Wet clothes combined with cold temperatures can lead to hypothermia. If the air temperature is less than 40 °F and an employee perspires, the employee must change to dry clothes.

The following are the five degrees of cold stress in increasing order of severity:

1. Incipient frostbite is a mild form of cold stress characterized by sudden blanching or whitening of the skin.
2. Chilblain is an inflammation of the hands and feet caused by exposure to cold moisture. It is characterized by a recurrent localized itching, swelling, and painful inflammation of the fingers, toes, or ears. Such a sequence produces severe spasms, accompanied by pain.
3. Second-degree frostbite is manifested by skin with a white, waxy appearance that is firm to the touch. Individuals with this condition are generally not aware of its seriousness because the underlying nerves are frozen and unable to transmit signals to the body. Immediate first aid and medical treatment are required.
4. Third-degree frostbite will appear as blue, blotchy skin. The tissue is cold, pale, and solid. Immediate medical attention is required.
5. Hypothermia develops when body temperature falls below a critical level. In extreme cases, cardiac failure and death may occur. Immediate medical attention is warranted when the following symptoms are observed: involuntary shivering, irrational behavior, slurred speech, and sluggishness.

To care for any frostbite, handle the area gently. Never rub an affected area because rubbing causes further damage to soft tissues. Warm the affected area gently by soaking the affected part in water no warmer than 105°F. Keep the frostbitten part in the water until it looks red and feels warm. Loosely bandage the affected area with a dry, sterile dressing. If fingers or toes are frostbitten, place cotton or gauze between them. Do not break any blisters caused by frostbite. Obtain professional medical attention as soon as possible.

To treat hypothermia, start by caring for any life-threatening problems and call for emergency medical assistance. Remove any wet clothing and dry the victim. Warm the body gradually by wrapping the victim in blankets or putting on dry clothing and moving him or her to a warm place. If available, apply heat pads or other heat sources to the body, but be sure to keep a barrier such as a blanket, towel, or clothing between the heat source and the victim to avoid burning the victim. If the victim is alert, give warm liquids to drink. Do not warm the victim too quickly, such as by immersing the victim in warm water, because rapid rewarming can cause dangerous heart problems. In cases of severe hypothermia, the victim may be unconscious. Should the victim stop breathing,

give rescue breathing, and be prepared to administer cardiopulmonary resuscitation (CPR).

#### **4.3.3 Materials Handling**

The most common type of materials handling accident involves fingers or toes of field personnel being caught between two objects. Special precautions must be implemented during the moving, shifting, or rolling of materials; and these activities should never be attempted by a single individual. Workers are required to use proper lifting techniques for handling materials, and oversized or heavy loads require "team lift" procedures.

#### **4.3.4 Utility Hazards**

The locations of all underground utilities must be identified and marked prior to initiating any subsurface investigations. In addition, drilling within 20 feet in any direction of overhead power lines will not be permitted.

### **4.4 BIOLOGICAL HAZARDS**

The biological hazards that could be encountered by site personnel include, but are not limited to, the following:

- Poisonous Animals
- Ticks
- Animal-Borne Diseases
- Poisonous Plants (e.g., poison sumac, poison ivy, poison oak)

Control measures to protect site personnel from these biological hazards are included in the following sections.

#### **4.4.1 Poisonous Animals**

Poisonous animals that pose a potential threat at NAS Fort Worth JRB include snakes, insects (ants, bees, wasps), and spiders. Rattlesnakes are the most common poisonous snakes in the area. Reactions from snakebite are aggravated by acute fear and anxiety. Other factors that affect the severity of local and general reaction from a poisonous snakebite include the amount of venom injected and the speed of absorption of venom into the victim's circulatory system; the size of the victim; protection provided by clothing, including shoes and gloves; quick anti-venom therapy; and location of the bite. Poisoning can occur from injection or absorption of venom through cuts or scratches. Personnel should avoid walking in grass or underbrush at night and not climb rocky ledges without prior visual inspection. Field personnel should wear high-top boots and heavy pants since more than half of all snakebites are on the lower parts of the legs.

Workers should not attempt to kill snakes unnecessarily as many people are bitten in such attempts.

Biting and stinging insects, such as ants, bees, and wasps, are very common. Generally, the bite and stings from these insects, although painful, are not dangerous; however, if bitten or stung by a large number of these insects, an individual may experience serious injury or even death. This is especially true of individuals who are particularly sensitive or allergic to insect toxins. Most of these insects live in easily recognizable nests, but many are encountered far from their nest. Care should be taken when entering little-used structures (sheds, utility buildings) and when opening monitoring well covers.

Spiders in the United States are generally harmless, with two notable exceptions: the black widow spider (*Latrodectus mactans*) and the brown recluse or violin spider (*Lox osceles reclusa*). The symptoms of a black widow spider bite are slight local reaction, severe pain produced by nerve toxin, profuse sweating, nausea, painful cramps in abdominal muscles, and difficulty in breathing and speaking. The symptoms of a brown recluse spider bite can be mild to severe. In the mildest form, the bite can cause pain and swelling like a bee sting or ant bite. If the reaction is severe, the bite area may become swollen, painful, and weep fluid. Swelling and reddening may spread to an entire limb, and if left untreated, the bite may cause necrosis of surrounding tissue and infection. Diarrhea, stomach cramps, and hot/cold flashes may also occur. Victims of poisonous spider bites recover in almost all cases, but an occasional death is reported.

Field personnel should exercise caution when lifting items such as logs, rocks, covers to manholes, and sump covers where poisonous animals could be encountered.

#### **4.4.1.1 First Aid Procedures (Snakebite)**

The objective of first aid is to reduce the circulation of blood through the bite area, to delay absorption of venom, to prevent aggravation of the local wound, and to sustain respiration. Several steps are listed to properly care for a snakebite victim. The most important step is to get the snakebite victim to the hospital quickly. In addition, take the following first aid measures:

- Keep the victim from moving around.
- Keep the victim as calm as possible and preferably in a lying position.
- Immobilize the bitten extremity and keep it at or below heart level. If the victim can reach a hospital within 4 to 5 hours, and if no symptoms develop, no further first aid measures need to be applied.
- If mild-to-moderate symptoms develop, apply a constricting band 2 to 4 inches above the bite, but not around a joint (the elbow, knee, wrist, or ankle) and not around the head, neck, or trunk. The band should be  $\frac{3}{4}$  to  $1\frac{1}{2}$  inches wide, not thin like a rubber band. The band should be snug but loose enough for a finger to

be slipped underneath. Watch for swelling and loosen the band if it becomes too tight, but do not remove it. Periodically check the pulse in the extremity beyond the bite to insure that the blood flow has not completely stopped.

Several other factors must be considered in cases of snakebite:

**Shock.** Keep the victim lying down and comfortable, and maintain his or her body temperature.

**Breathing and heartbeat.** If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform CPR if you have been trained to do so.

**Identifying the snake.** If you can kill the snake without risk or delay, bring it to the hospital for identification, but exercise extreme caution in handling the snake.

**Cleaning the bitten area.** You may wash the bitten area with soap and water and blot it dry with sterile gauze. You may apply dressings and bandages, but only for a short period of time.

**Medicine to relieve pain.** Do not give the victim alcohol, sedatives, aspirin, or any medicine containing aspirin. Consult a doctor or other medical personnel for specific medications that may be used.

It is not recommended that cold compresses, ice, dry ice, chemical ice packs, spray refrigerants, or other methods of cold therapy be used in the first aid treatment of a snakebite.

#### **4.4.1.2 General First Aid for Poisonous Insect Bites/Stings**

For minor bites and stings use cold applications and soothing lotions, such as calamine. For more severe reactions, take the following first aid measures:

Apply a constricting band above the injection site on the victim's arm or leg (between the site and the heart). Do not apply tightly. You should be able to slip your index finger under the band when it is in place. Give artificial respiration if necessary.

- Keep the affected part below the level of the victim's heart.
- If medical care is ready available, leave the band in place; otherwise, remove it after 30 minutes.
- Apply ice contained in a towel or plastic bag, or cold cloths, to the site of the sting or bite.
- Give home medicine, such as aspirin, for pain.

If the victim has a history of allergic reactions to insect bites/stings or is subject to attacks of hay fever or asthma, or if he or she is not promptly relieved of symptoms, call a physician or take the victim immediately to the nearest location where medical treatment is available. **In a highly sensitive person, do not wait for symptoms to appear, since delay can be fatal.**

In case of a bee sting, use tweezers to remove and discard the stinger and venom sac.

Workers who have had severe allergic reactions to bee/wasp stings in the past must inform the SSO when they arrive at the site for the first time.

#### 4.4.2 Ticks

Field personnel should be aware of the presence of ticks at the site. When in an area suspected of harboring ticks (grassy, bushy, or woodland area) the following precautions can minimize the chances of being bitten by a tick:

- Wear long pants and long-sleeved shirts that fit tightly at the ankles and wrists.
- Wear light colored clothing so ticks can be easily spotted.
- Wear tick repellents.
- Inspect clothing frequently while in tick habitat.
- Inspect your head and body thoroughly when you return from the field.

Removal of ticks is best accomplished using small tweezers. Do not squeeze the tick's body. Grasp it where the mouthparts enter the skin and tug gently, not firmly, until it releases its hold on the skin. Save the tick in a jar labeled with the date, body location of the bite, and the place where it may have been acquired. Wipe the bite thoroughly with an antiseptic. Seek medical attention in the event tick-related disease symptoms develop.

Lyme disease is an illness caused by a bacterium that may be transmitted by the bite of a tick (*Ixodes dammini*), commonly referred to as the deer tick. Not all ticks are infected with the bacterium, however. When an infected tick bites, the bacterium is passed into the bloodstream of the host, where it multiplies. The various stages and symptoms of the disease are well recognized and, if detected early, can be treated with antibiotics.

The illness typically occurs in the summer and is characterized by a slowly expanding red rash, which develops a few days to a few weeks after the bite of an infected tick. This may be accompanied by flu-like symptoms along with headache, stiff neck, fever, muscle aches, and/or general malaise. At this stage, treatment by a physician is usually effective, but, if left too long, these early symptoms may disappear and more serious problems may follow. The most common late symptom of the untreated disease is arthritis. Other problems that may occur include meningitis and neurological and cardiac abnormalities. It is important to note that some people do not get the characteristic rash but progress



directly to the later manifestations. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

#### 4.4.3 Animal-Borne Diseases

There are three principal diseases that can be transmitted by contact with rodents and other animals: rabies, bubonic plague, and hantavirus pulmonary syndrome (HPS). For this reason, field personnel will avoid all contact with rodents and other animals (alive or dead), rodent droppings, and rodent nests. All of these should be considered to be potentially contaminated with life-threatening pathogens.

Rabies is a disease that is transmitted through the saliva of rodents, as well as other mammals, such as dogs, cats, raccoons, foxes, bats, and cattle. An animal infected with the disease may act strangely (e.g., not afraid of humans, out at the wrong time of day or night), drool, or appear partially paralyzed. **If left untreated, rabies is a fatal disease.** If someone is bitten by an animal, treat the wound first, especially if the bleeding is serious, then get the person immediate medical attention. Do not attempt to kill or capture the animal, as further injuries could result. Call the local animal control authorities, and provide them with a description of the animal and the location of the incident.

Bubonic plague is the disease that was the cause of the plague known as the Black Death, which decimated the populations of Europe in the Middle Ages and Renaissance. The disease is caused by a bacterium carried by the oriental rat flea, *Xenopsylla cheopis*, which is found on rats, mice, and jackrabbits. Epidemics of the disease do not occur in the U.S., but isolated cases have occurred in the southwestern states. The symptoms of the disease are a dark, pimple-like inflammation at the site of the bite, followed by a swelling of the lymph node closest to the bite area. The victim will develop an extremely high fever and dark splotching due to subcutaneous hemorrhaging. Untreated bubonic plague has a mortality rate of approximately 60 percent; however, the disease responds well when treated promptly with antibiotics (though not penicillin).

HPS is an infectious respiratory disease caused by exposure to the hantavirus. While cases of HPS are rare (generally less than 50 per year), HPS is fatal in approximately half the reported cases. This virus is present throughout the southwestern U.S. and is carried by rodents, especially mice. The virus enters the human body by the inhalation of particles, such as dust, which has become contaminated by the virus by exposure to rodent saliva, urine, or droppings. If personnel are exposed to rodents, droppings, or rodent nests, get immediate medical attention. HPS can be diagnosed using an antibody test. The symptoms of HPS are initially flu-like; after three to five days, the victim will develop coughing and shortness of breath, which will rapidly become more serious. At this point, it is imperative that the victim receives medical attention. If treated in time, there is an excellent chance of surviving the disease; however, untreated HPS is very often fatal.

Armadillos are common in the Fort Worth area. These animals are nocturnal and avoid humans, but are often found dead, especially along roads. It is estimated that 5 percent of these animals carry the bacillus that causes leprosy, *Mycobacterium leprae*. This disease is not very contagious (it is believed that up to 95 percent of all humans are naturally immune); however, all dead armadillos encountered at the site should be treated as potentially infectious and avoided.

#### **4.4.4 Poisonous Plants**

The majority of skin reactions following contact with offending plants are allergic in nature and are characterized by general symptoms of headache and fever, itching, redness, and rash.

Some of the most common and most severe allergic reactions result from contact with plants of the poison ivy group including poison ivy, poison oak, and poison sumac. The most distinctive features of poison ivy and poison oak are their leaves, which are composed of three leaflets each. Both plants also have greenish-white flowers and berries that grow in clusters. Such plants produce a severe rash characterized by redness, blistering, swelling, and intense burning and itching. The victim can also develop a high fever and become very ill. Ordinarily, the rash begins within a few hours after exposure, but it may be delayed for 24 to 48 hours.

##### **4.4.4.1 First Aid Procedure**

1. Remove contaminated clothing.
2. Wash all exposed areas thoroughly with soap and cold water, followed by rubbing alcohol.
3. Apply calamine or other soothing skin lotion if the rash is mild.
4. Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity.

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## **5. HAZARD COMMUNICATION**

The SAIC Hazard Communication Program complies with the OSHA hazard communication standard (HCS) found in OSHA Standard 29 CFR 1910.120 and 1926.59, which applies to any chemical present in the workplace in such a manner that employees may be exposed to under normal conditions of use in a foreseeable emergency. Although waste materials are excluded from the OSHA requirements, decontamination chemicals for sampling equipment or protective clothing and calibration standards require MSDSs.

The principle of communicating the hazards of materials used in the workplace applies to company-wide activities, from informational programs on the conduct of hazardous waste activities to the company's insistence upon adequate health and safety training. It is also important for personnel to have an awareness of client concern for hazard communication due to Federal, state, and local regulations directly affecting certain client activities.

In order to comply with the HCS, SAIC has made the following determinations:

All containers of hazardous chemicals must be appropriately labeled or tagged to identify the hazard and provide information on effects and appropriate protective measures.

Labels, tags, or signs must be properly affixed and visible at all times while a hazard is present and removed promptly when the hazard no longer exists.

Written information (i.e., MSDSs) on hazardous chemicals in the workplace must be available to employees working with the substances.

Appropriate MSDSs will be available to any contractor or subcontractor employee working on projects under SAIC's control.

When investigation results indicate potential imminent health risks to contracted or federal personnel, or the public at large, the COR and the base point of contact (POC) will be notified as soon as practicable. Written notification and supporting documentation will be provided within 3 days of finding potential imminent health risks during investigation activities.

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## **6. AIR MONITORING**

This section presents requirements for the use of real-time air monitoring instruments during site activities involving potential for exposure to site contaminants. It establishes the types of instruments to be used, the frequency of their use, the techniques for their use, the action levels for upgrading/downgrading levels of protection, and the methods for instrument maintenance and calibration.

### **6.1 INSTRUMENTS AND USE**

A photoionization detector (PID) equipped with an appropriate lamp will be utilized for detecting the presence of emissions from chemicals of concern. Lower explosive limit/oxygen (LEL/O<sub>2</sub>) detectors will be used during all drilling and excavation activities to detect the presence of flammable/explosive atmospheres. Visual observation will be used to detect the presence of airborne particulate.

The PID will be used throughout the execution of these activities:

- Soil boring installation
- Soil sampling
- Sampling equipment decontamination/heavy equipment decontamination
- Waste characterization and disposal

### **6.2 AIR MONITORING REQUIREMENTS**

#### **6.2.1 Photoionization Detector**

Air monitoring with the PID will be initiated at potential sources of vapor emissions (source monitoring) at specified frequencies. The frequencies will be increased where concentrations of constituents are measured. The following potential sources and monitoring frequencies are anticipated:

- The PID will be used to monitor each sample location during environmental sampling.
- The PID will be used to monitor each 5-foot interval during surface and subsurface soil sampling.

If source monitoring indicates the presence of airborne emissions, air monitoring will then be initiated in the breathing zones of those workers who could be affected by the emissions. Air monitoring will also occur upon the request of site workers who notice unusual site odors or an increase in their intensity. If work is to be performed downwind of a site, air

monitoring will be conducted to determine what type of PPE, if any, is required to protect workers and to determine the potential for an imminent threat to public health.

The presence of elevated readings in the worker's breathing zone as identified in Table 6-1 requires amendments to the HSP before workers are allowed to enter the exclusion zone. Depending on the air monitoring readings, air-purifying respirators may not be acceptable because some contaminants of concern have poor warning properties and/or cannot be filtered from inspired air with chemical cartridges (Table 6-1).

### **6.2.2 LEL/O<sub>2</sub> Detectors**

Air monitoring with the LEL/O<sub>2</sub> detectors will be conducted during all drilling and excavation activities within boreholes and immediately over drill cuttings at every 5-foot depth interval. If elevated (above background) LEL readings are observed, personnel must be advised of the potential explosive nature and must initiate the use of spark proof tools in accordance with Table 6-1. LEL readings in excess of 10 percent require cessation of drilling and abandonment of the drilling location until readings subside.

### **6.2.3 Visual Observations**

If airborne particulate are observed and air monitoring results (as indicated in Table 6-1) warrant, personnel must don air-purifying respirators equipped with organic vapor cartridges and high efficiency particulate air filters. If airborne particulates are observed due to intrusive activities at these sites, dust control measures will be implemented.

## **6.3 MODIFICATION OF AIR MONITORING REQUIREMENTS**

The action levels and protection measures presented in Table 6-1 are based upon the assumption that the contaminants listed in Table 4-1 are the only contaminants that pose a reasonable health risk to site workers. In the event that this assumption is found to be invalid through analysis of samples collected, or by some other means, the action levels will be modified as necessary.

## **6.4 INSTRUMENT MAINTENANCE AND CALIBRATION**

Air monitoring instruments are maintained and prefield-calibrated at the SAIC field office. Field maintenance will consist of daily cleaning of the instruments using a damp towel or rag to wipe off the instrument's outer casing, overnight battery recharging, and cleaning or replacing of the lamp whenever calibration cannot be attained. Procedures for accomplishing instrument maintenance is contained in the PID user's manual provided with each instrument. The user's manual provided with each instrument will be followed to field calibrate the instrument prior to each day of use under the environmental conditions (temperature and humidity) that sampling will occur. Field equipment will also be calibrated at the end of each day to account for instrument drift and reliability.

**Table 6-1**  
**Hazard Monitoring Methods, Action Levels,**  
**and Protection Measures**

<b>Hazard</b>	<b>Monitoring Method</b>	<b>Action Level</b>	<b>Protective Measures</b>	<b>Monitoring Schedule</b>
Toxic Vapors (as identified in Table 4.1)	PID	0.0 to <0.5 ppm above background based on judgment of SSO	Level D (see Table 7-1)	<ul style="list-style-type: none"> <li>continue with regular monitoring of breathing zone</li> </ul>
		0.5 ppm above background based on judgment of SSO	Level D (see Table 7-1)	<ul style="list-style-type: none"> <li>if confirmed as vinyl chloride and/or benzene, then see vinyl chloride/benzene hazard identified below</li> <li>if denied as vinyl chloride and benzene, then continue with regular monitoring of breathing zone</li> </ul>
		>0.5 ppm to <25 ppm above background based on judgment of SSO (if denied as vinyl chloride and benzene)	Level D (see Table 7-1)	<ul style="list-style-type: none"> <li>if confirmed as vinyl chloride and/or benzene, then see vinyl chloride/benzene hazard identified below</li> <li>if denied as vinyl chloride and benzene, then continue with regular monitoring of breathing zone</li> <li>if confirmed as tetrachloroethene or TCE, then see hazard identified below</li> <li>if denied as tetrachloroethene or TCE, then continue with regular monitoring of breathing zone</li> </ul>
Toxic Vapors (cont.) (as identified in Table 4.1)	PID	>25 to <250 ppm above background based on judgment of SSO (if denied as vinyl chloride, benzene, and tetrachloroethene)	Level C (see Table 7-1)	<ul style="list-style-type: none"> <li>continue with regular monitoring of breathing zone</li> <li>contact HSO and Project Manager</li> <li>continue attempt to identify unknown air contaminants</li> </ul>
Flammable/Explosive Gases and/or Vapors	LEL/O <sub>2</sub> Detector	0.0 to 5.0 percent LEL	notify sampling team of readings	<ul style="list-style-type: none"> <li>prior to and during sampling activities, monitor all areas suspected of containing flammable/explosive gases and/or vapors</li> </ul>
		5.0 to <10.0 percent LEL	use spark proof equipment/tools	<ul style="list-style-type: none"> <li>continue with regular monitoring of breathing zone</li> </ul>
		>10.0 percent LEL	STOP WORK, EVACUATE AREA, NOTIFY PROJECT MANAGER	<ul style="list-style-type: none"> <li>continue with regular monitoring of breathing zone</li> <li>notify HSO and Project Manager</li> <li>requires HSP amendments unless readings subside</li> </ul>
Toxic Vapors (as identified in Table 4.1)	PID	>250 above background based on judgment of SSO (if denied as all chemicals listed above)	STOP WORK, EVACUATE AREA, NOTIFY PROJECT MANAGER	<ul style="list-style-type: none"> <li>requires identification of new chemical hazard and HSP amendments</li> </ul>
PID LEL/O <sub>2</sub> SSO ppm	photoionization detector lower explosive limit/oxygen Site Safety Officer parts per million		TCE HSO HSP	trichloroethene Health and Safety Officer Health and Safety Plan



## 6.5 RECORD KEEPING

Instrument calibrations and readings will be recorded on the Air Monitoring Log Sheet provided in Section 14.1 of this HSP. Copies of these log sheets will be maintained on-site until field activities covered by this HSP have been completed. The log sheets will be transmitted to the SAIC HSO and to the project file at the completion of the fieldwork.

LEL/O<sub>2</sub> readings will not be recorded unless flammable/explosive or oxygen deficient/enriched atmospheres are detected, in which case entries will be made in the field logbook.

LEL/O<sub>2</sub> detector, and the PID will undergo daily operational checks. These checks will be recorded in the field logbook and Equipment Calibration Log (Section 14.1).

## 7. PERSONAL PROTECTIVE EQUIPMENT

This section presents requirements for the use of PPE for each of the activities being conducted. This section includes anticipated levels of protection for each of the activities, the criteria used for selecting various levels of protection, and criteria for modifying levels of protection based on monitoring instrument readings, and personal observations.

### 7.1 ANTICIPATED LEVELS OF PROTECTION

Most work is anticipated to be performed in Level D protection, as defined in Appendix B of OSHA Standard 29 CFR 1910.120. Many activities may require the use of chemical resistant coveralls, gloves, and boot covers as presented in Table 7-1.

The items of PPE anticipated to be used for each activity are presented in Table 7-1. Where overlap in activities occurs, the more protective requirement will apply.

**Table 7-1**  
**Protective Equipment for On-Site Activities**

Activity	Level	Protective Equipment
Surface Soil Sampling Subsurface Soil Sampling Groundwater Sampling	D	<ul style="list-style-type: none"> <li>• Street clothes or overalls (long sleeves)</li> <li>• Impermeable safety boots/shoes (steel-toed)</li> <li>• Safety glasses/goggles (if hazard to eyes exists)</li> <li>• Hard hat (if hazard to head exists)</li> <li>• Gloves (nitrile, neoprene)</li> <li>• Ear plugs/defenders (if hazard exists)</li> </ul>
	D (modified)	<ul style="list-style-type: none"> <li>• Rubber boots, chemically-resistant with steel toe</li> <li>• Gloves (nitrile, neoprene)</li> <li>• Tape for sealing ankle and wrist openings</li> <li>• Hard hat (if hazard to head exists)</li> <li>• Safety glasses/goggles (if hazard to eyes exists)</li> <li>• Unbolted Tyvek or equivalent</li> <li>• Ear plugs/defenders (if hazard exists)</li> </ul>

### 7.2 PPE SELECTION CRITERIA

Respiratory protection is not anticipated for use during the initial stages of work until detectability of site contaminants with air monitoring instruments warrants the donning of respirator protection in accordance with Table 6-1. See Section 7.3 for modification criteria of respiratory protection. Basic requirements for field personnel using respiratory protection include the following:

All field personnel will be medically certified to wear a full-face respirator and have the proper fit test documentation within the past 12 months prior to assignment.

Only NIOSH-approved respirators are to be used on-site. The respirators are to be properly cleaned, inspected, and maintained prior to and at the conclusion of the workday.

Cartridges to air-purifying respirators will be disposed of at the end of each workday and when load-up or breakthrough occurs.

Field personnel will be clean shaven in areas that might prevent the seal of the respirator to the face, and contact lenses will not be permitted while wearing a respirator.

Hard hats, safety glasses, and steel-toe work boots will be used as minimum protection to reduce the potential for injury resulting from exposure to the physical hazards associated with on-site investigations.

Boot covers, disposable nitrile gloves, and Tyvek coveralls will be used to minimize contamination of work clothes and to prevent direct skin contact with low level contamination. Nitrile gloves of 11 mil thickness or greater will be worn for activities that may involve direct contact with appreciable concentrations of contaminants thought to be present as site contaminants.

Polyvinyl chloride (PVC) or Saranex™ coveralls, hoods, and/or splash shields will be worn to prevent saturation of work clothes during activities involving large volumes of liquids and/or saturated soils/equipment.

### **7.3 PPE MODIFICATION CRITERIA**

This section presents criteria for upgrading and downgrading chemical protective clothing (CPC) and/or respiratory protection. When uncertainties arise, the more protective requirement will apply.

#### **7.3.1 CPC Modification Criteria**

Tyvek coveralls and boot covers must be worn anytime there is a reasonable potential for contamination of street clothes.

Disposable nitrile gloves must be worn anytime there is a reasonable potential for contact with unsaturated soils or equipment that may contain trace contamination.

Nitrile gloves (11 mil or greater) must be worn anytime there is a reasonable potential for contact with groundwater, saturated soils, and/or soils producing elevated PID readings.

PVC or Saranex coveralls must be worn anytime there is a reasonable potential for saturation of work clothes.

## 8. DECONTAMINATION

This section describes the steps site personnel will follow to prevent the spread of site contaminants into areas that may affect unprotected, unsuspecting site personnel or the public. It includes requirements for decontamination of personnel, sampling equipment, and auguring/drilling equipment.

### 8.1 PERSONNEL DECONTAMINATION

The decontamination of personnel and their protective clothing will be performed within the decontamination zone. Table 8-1 presents the six stages for decontamination for Modified Level D protection.

**Table 8-1**  
**Six Stages for Decontamination in Modified Level D Protection**

Stage	Procedure
Stage 1: Segregated Equipment Drop	Deposit equipment used on-site on plastic drop cloths or in assigned containers with plastic liners.
Stage 2: Boot Cover and Glove Wash	Scrub outer boot covers and gloves with decontamination solution, and rinse with water.
Stage 3: Tape Removal	Remove tape around boots and gloves and deposit in container with plastic liner.
Stage 4: Remove boots, gloves, and disposable clothing	Deposit in appropriate plastic-lined container Discard disposable clothing.
Stage 5: Field wash	Wash hands and face with soap and water.
Stage 6: Redress	Put on clean clothes.

Wash tubs containing an appropriate decontamination solution and soft-bristle brushes will be used to wash reusable PPE and boots. Clean water will be used for the final rinse. The choice of decontamination solution is dependent upon the type of materials that must be removed from reusable protective equipment. Based on the current understanding of potential site contaminants, a detergent and water solution is recommended for general purpose decontamination. Acceptable detergents include laboratory-grade cleaners (e.g., Alconox or equivalent), or a high strength consumer detergent such as Liquid Tide.

All decontamination fluids generated will be contained and disposed of as specified in the Work Plan. The decontamination area will be physically identified with rope or flagging and will be sufficiently equipped to be conducive for completion of the stages listed above.

#### 8.1.1 Closure of the Personnel Decontamination Station

All disposable clothing and plastic sheeting used during the operation will be double-bagged and contained on-site prior to removal to an approved off-site disposal

facility as identified in the Work Plan. Decontamination and rinse solution will be contained on-site prior to disposal. Reusable rubber clothing will be dried and prepared for future use. If contamination of non-disposable clothing has occurred, the item will be discarded. All wash tubs, pail containers, etc., will be thoroughly washed, rinsed, and dried prior to removal from the site.

#### **8.1.2 Disposal of Decontamination and Other Wastes**

All PPE, polyethylene sheeting, and sampling support materials (e.g., paper towers, ziplock bags) will be collected at the end of each work day, placed in plastic trash bags, and left at the site overnight. The following day, the air within the plastic trash bag will be tested using a PID. If the air within the bag does not show significant concentrations of organic vapors (greater than 10 ppm above background), the plastic trash bag will be double-bagged and placed in the municipal waste dumpster for disposal.

All other wastes generated during decontamination other than decontamination fluids will be placed into 55-gallon drums; each drum will have a removable top cover fitted with a top cover bung (type 17E/H) as identified in the FSP. The drums will be filled partially or completely, depending upon the difficulty of transporting them from the work site. All containers will be numbered and clearly labeled with the boring/well number and date of filling. The mixing of solid and liquid wastes will be avoided. The containers will be stored at a predesignated site until the analytical results from each boring/well can be reviewed in order to determine the waste classification for handling, transportation, and disposal.

### **8.2 EQUIPMENT DECONTAMINATION**

All sampling equipment will be decontaminated prior to use, between sampling locations, and at the end of sampling activities to avoid cross-contamination, to decrease contact between personnel and contaminated materials, and to reduce the probability of removing contamination from the site. The procedures for decontaminating equipment are presented in Section 5.8 of the FSP.

## **9. MEDICAL SURVEILLANCE**

### **9.1 REQUIREMENTS FOR SAIC PERSONNEL**

All employees involved in field activities will be active participants in the SAIC medical surveillance program. All medical examinations and procedures will be performed by or under the supervision of a licensed occupational physician. The examination will include the tests, procedures, and frequencies that comply with the requirements of OSHA Standard 29 CFR 1910.120 (f) and American National Standards Institute (ANSI) Z-88.2, and personnel will be medically qualified to perform hazardous waste site work under respiratory protection. Medical surveillance documents confirming the worker's fitness to perform hazardous waste operations on this project will be maintained on-site and will be available for inspection upon request.

### **9.2 REQUIREMENTS FOR SUBCONTRACTORS**

Subcontractors are also required to obtain a certificate of their ability to perform hazardous waste operations work and to wear respiratory protection. Subcontractors, that have a company medical surveillance program meeting the requirements of OSHA Standard 29 CFR 1910.120 (f) will be required to submit a letter, on company letterhead, confirming that all on-site workers to be utilized for this project are medically qualified to perform the investigation activities. In addition, medical surveillance documents for personnel assigned to this project must be maintained at the work site and made available for inspection upon request.

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## **10. TRAINING REQUIREMENTS**

### **10.1 INITIAL TRAINING**

#### **10.1.1 Requirements for SAIC Personnel**

All investigation personnel to be utilized are currently enrolled in SAIC's continuous training program in accordance with OSHA Standard 29 CFR 1910.120. Individuals working on a site have successfully completed an approved 40-hour Hazardous Waste Site Operations (HAZWOPER) course including 24-hours of actual field experience under the direction of a trained supervisor, and any subsequent annual 8-hour refresher courses. In addition, a majority of SAIC's field personnel are also current in first aid/CPR training requirements. SAIC employee records will be maintained on site.

#### **10.1.2 Requirements for Subcontractors**

All SAIC subcontractor personnel must also have completed a 40-hour HAZWOPER training course or the equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e) prior to performing work at the site. In addition, subcontractor personnel must also have successfully completed any subsequent annual 8-hour refresher training.

SAIC subcontractors must certify that each subcontractor employee who will perform work at the site has had training meeting the requirements of OSHA Standard 29 CFR 1910.120(e). This certification can be accomplished by submitting copies of training certificates along with a cover letter to SAIC on company letterhead.

#### **10.1.3 Requirements for Site Visitors**

No person will be allowed in the work zones (exclusion and decontamination) unless they have completed the necessary health and safety training as required by OSHA Standard 29 CFR 1910.120(e) (proof of current certification required) and are wearing the necessary protective equipment as required by this HSP.

### **10.2 SITE SPECIFIC TRAINING**

SAIC will provide site-specific training to all SAIC employees and subcontractor personnel who will perform work at the site. Health and safety meetings will be held prior to beginning field activities to discuss each day's activities, potential hazards, and any new health and safety issues not previously discussed. Personnel who do not participate in training will not be permitted to perform work at the site. Site-specific training will include the following:



- Contents of the HSP.
- Names of personnel and alternates responsible for site health and safety.
- Safety, health, and other hazards present on the site.
- Use of PPE including Level C equipment.
- Work practices by which the employees can minimize risks from hazards.
- Safe use of engineering controls and equipment on the site.
- Medical surveillance requirements, including recognition of symptoms and signs that might indicate overexposure to hazards.
- Decontamination procedures.
- Emergency response procedures.
- SAIC and subcontractor personnel will be required to sign a statement indicating receipt of site-specific training and understanding of site hazards and control measures. This form is presented in Section 14.1.

## **11. STANDARD WORK PRACTICES**

All site investigation activities will follow these appropriate health and safety standard work practices.

### **11.1 GENERAL REQUIREMENTS/PROHIBITIONS**

A copy of this HSP will be available on-site for all field personnel, including visitors, to reference during investigation activities.

- No running or horseplay will be permitted.
- Eating, drinking, chewing gum or tobacco, taking medication, applying cosmetics, and/or smoking are prohibited in the exclusion and decontamination zones, or any location where a possibility for contact with site contaminants exists.
- The minimum required level of PPE to be worn by all on-site personnel will include steel-toed safety boots, safety glasses, and hard hat, if necessary.
- Upon leaving the exclusion zone, each worker's hands and face must be thoroughly washed. Any protective outer clothing is to be decontaminated and removed as specified in this HSP and left at a designated area prior to entering the clean area.
- Contact with potentially contaminated substances must be avoided. Contact with the ground or with contaminated equipment must also be avoided. Air monitoring equipment must not be placed on potentially contaminated surfaces.
- Facial hair that interferes with a satisfactory fit of the mask-to-face seal is not permitted on personnel required to wear respiratory protective equipment.
- All personnel must satisfy medical monitoring procedures.
- No flames or open fires will be permitted on-site.
- All personnel must be aware of and follow the action levels presented in this HSP for upgrading respiratory protection.
- Any new analytical data must be promptly conveyed via telephone to the project HSO by the laboratory technician or field leader.

Personnel must develop hand signals with users of heavy equipment (e.g., drillers, geoprobe operators, etc.). Standard hand signals to be used by personnel for nonverbal communication include:

1. **Stop**                      With arm extended to the side and palm down, hold position rigidly.
2. **Emergency**            With arm extended to the side and palm down, move hand rapidly right and left.

Standard hand signals will be discussed during each daily health and safety meeting when the use of heavy equipment is anticipated.

A copy of the OSHA "Job Safety and Health Protection" poster must be prominently posted at each site.

Only equipment that has been approved by the manufacturer may be used in conjunction with site equipment.

Medicine and alcohol can potentiate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel on operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Alcoholic beverage intake will not be allowed at any time, including during breaks.

- No person will enter the exclusion zone alone.
- Safety devices on equipment must be left intact and used as designed.
- Equipment and tools will be kept clean and in good repair and used only for their intended purpose.
- Eye protection must be worn when any hammering or pounding is performed that may produce flying particles or slivers.

Field personnel are not allowed to lift more than 60 pounds. Rules to remember when attempting to lift heavy objects include:

- Size up the load before trying to lift it, test the weight, and get help if needed.
- Bend the knees and look up to keep the neck and back straight.
- Do not twist or turn your body once you have made the lift.
- Make sure you can carry the load where you need to go before lifting it.
- Set the load down properly, lower slowly by bending the knees.
- Always push, not pull, the object when possible.

Heavy lifting (more than 60 pounds per worker) must be accomplished using mechanical lifting equipment. Mechanical lifting equipment that will be available on-site will include forklifts, hoists, dollies, backhoe/trackhoe, and other types of equipment that can be easily rented from an off-site location.

Leather gloves must be worn when handling objects that may produce slivers or create a cutting or pinching hazard (e.g., driving wood stakes, handling drill rods/augers).

No person shall climb the drill mast without the use of ANSI-approved fall protection (i.e., approved belts, lanyards, and a fall protection slide rail) or a portable ladder that meets the requirements of OSHA standards.

The SSO must make an entry into the site field logbook at least daily to include the following:

- Weather conditions.
- Site personnel.
- New arrivals and their clearance for site work.
- Air monitoring data summary.
- Monitoring instrument calibration.
- Indications of inhalation exposure.
- PPE used per task.
- Deviations from HSP.
- Inspection and cleaning of respiratory equipment.
- General health and safety problems/corrective actions.

If personnel note any warning properties of chemicals (irritation, odors, symptoms, etc.) or even remotely suspect the occurrence of exposure, they must immediately notify the SSO for further direction.

## **11.2 DRILLING ACTIVITIES**

Prior to the commencement of drilling activities, all locations will be surveyed and marked for underground utilities. In addition, a hand auger or probe will be used to a depth of 3 feet to ensure the absence of underground utilities at the location of interest. If any uncertainties exist, the location will be moved to an adjacent area.

The following general drilling practices must be adhered to during investigation activities:

- All drilling equipment (i.e., rigging, derrick, hoists, augers, etc.) must be inspected by the drilling crew and SSO prior to starting work. Defective equipment will be removed from service and replaced.
- No drilling within 20 feet in any direction of overhead power lines will be permitted. The locations of all underground utilities must be identified and marked prior to initiating any subsurface activities.
- All drill rigs and other machinery with exposed moving parts must be equipped with an operational emergency stop device. Drillers and geologists must be aware of the location of this device. This device must be tested prior to job initiation and periodically thereafter. The driller and helper shall not simultaneously handle moving augers or flights unless there is a standby person to activate the emergency stop.
- Prior to raising the mast, the drill rig operator shall ensure that the proper stabilization measures have been taken. The drill rig shall not be moved while the mast is in the raised position.
- The driller must never leave the controls while the tools are rotating unless all personnel are clear of the rotating equipment.
- Drillers must wear hearing protection unless the employer can provide documentation that noise exposures are less than a dose of 50 percent as required by OSHA Standard 29 CFR 1910.95.
- Drilling activities shall immediately cease when inclement weather (e.g., heavy rains, lightning) or high winds occur at the site. All site personnel should immediately seek shelter.
- To maintain a clean operation, drill cuttings shall be promptly containerized as they are generated. A long-handled shovel or equivalent must be used to clear drill cuttings away from the hole and from rotating tools. Hands and/or feet are not to be used for this purpose.
- A remote sampling device must be used to sample drill cuttings if the tools are rotating. Samplers must not reach into or near the rotating equipment. If personnel must work near any tools, that could rotate, the driller must shut down the rig prior to initiating such work.
- Drillers, helpers, and samplers must secure all loose clothing when in the vicinity of drilling operations.
- Only equipment that has been approved by the manufacturer may be used in conjunction with site equipment. Pins that protrude from augers will not be allowed.

A variety of additional work practices (i.e., hoisting, cat line, pipe and auger handling, etc.) are to be adhered to by the drilling crew, but will not be addressed in this HSP. If the on-site field team leader or site supervisor observes any operations or actions that are perceived as threatening to the health and safety of site personnel, drilling operations will be temporarily suspended until a mutual understanding of the action(s) in question has been reached.

Soil borings have the potential for releases to the environment and exposure to personnel. Gases and vapors that have a vapor density of less than 1.0 are lighter-than-air and tend to migrate upward in the atmosphere and disperse (e.g., methane). Heavier-than-air gases and vapors tend to stay close to the ground and may migrate to low-lying areas (e.g., hydrogen sulfide). In general, the only containment for a release to the air is termination of the release at the source (e.g., plug the boring). Depending on the contaminant encountered, it may be necessary to evacuate persons who are downwind of the area of the release. Emergency response personnel should be notified (Section 13.6) if air concentrations at the perimeter of the exclusion zone exceed threshold limit values or permissible exposure limits (PELs).

### **11.3 HOUSEKEEPING**

Housekeeping is a very important aspect of an investigation program and will be strongly stressed in all aspects of fieldwork. Good housekeeping plays an essential role in occupational health protection and is a way of preventing dispersion of dangerous contaminants. All work areas will be kept as clean as possible at all times and spills will be cleaned up immediately. Housekeeping will be the responsibility of all employees.

SAIC will implement a housekeeping program for the field activities to minimize the spread of contamination beyond the work site. The program will include the following:

- Daily scheduling to police the area of debris including paper products, cans, and other materials brought on-site
- Changing of wash and rinse water for hands, face, and equipment as needed
- Periodic (daily minimum) removal of all garbage bags and containers used to dispose of food products, plastic inner gloves, and contaminated disposable clothing

### **11.4 WORK LIMITATIONS**

All site activities will be performed during normal daylight hours.

## **11.5 SPILL CONTAINMENT**

The procedures defined in this section comprise the spill containment activities in place at the site.

- All drums and containers used during the cleanup will meet appropriate United Nations, OSHA, and USEPA regulations for the waste that they will contain.
- Drums and containers will be inspected and their integrity ensured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions will be positioned in an accessible location and inspected prior to further handling.
- Operations on-site will be organized so as to minimize the amount of drum or container movement.
- Employees involved in the drum or container operations will be warned of the hazards associated with the containers.
- Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (absorbent, pillows, etc.) will be stationed in the immediate area. The spill containment program must be sufficient to contain and isolate the entire volume of hazardous substances being transferred.
- Drums or containers that cannot be moved without failure will be emptied into a sound container.
- Fire extinguishing equipment meeting 29 CFR Part 1910, Subpart L shall be on hand and ready for use to control fires.

## **12. SITE CONTROL**

### **12.1 WORK ZONES**

Each investigation location will be physically barricaded with rope flagging or caution tape to control entry to and exit from the area. These barricaded areas will be referred to as the exclusion zones. The exclusion zone will be identified by the site supervisor and consist of a 20-foot radius surrounding the drilling location. Each person leaving an exclusion zone will proceed directly to the decontamination zone, which will be located adjacent to the exclusion zone and identified by physical barriers. The decontamination zone will consist of a low-lying area covered with a plastic sheeting. At the completion of decontamination procedures at each location, the debris will be enclosed in the plastic sheeting and deposited into 55-gallon type 17 E/H drums for later disposal as identified in the Work Plan and FSP. Only personnel who are cleared by the SAIC field leader and SSO will be permitted in the exclusion zones and/or decontamination zones. Clearance for accessing these areas will only be given to personnel who meet the training and medical surveillance requirements of OSHA Standard 29 CFR 1910.120 and are wearing the appropriate PPE required for the work activity.

The support zone, where the administrative, communications, and other support services will be based, will be in a controlled area off the site or on the far end upwind of potential site contamination or areas of potential exposure. Only persons and equipment that are free of contamination will be permitted in the support zone.

### **12.2 ON-SITE/OFF-SITE COMMUNICATIONS**

Communications will consist of a mobile phone stationed within the on-site vehicle utilized for transportation. Field personnel may also utilize telephones located at NAS Fort Worth JRB in emergency situations.



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### **13. EMERGENCY RESPONSE**

This HSP has been developed in an attempt to prevent the occurrence of situations that may jeopardize the health and safety of on-site personnel. However, supplemental emergency procedures must be identified in the event that an unforeseen health and safety accident or incident occurs. In general, SAIC will evacuate their employees and subcontractors from the workplace if an emergency involving chemical spills, chemical fires, chemical exposure, and/or chemical emissions occurs. For this reason, emergency response planning will be in accordance with OSHA Standard 29 CFR 1910.38(a).

#### **13.1 PREPLANNING**

Upon initial arrival at the site, the SAIC field team leader and SSO will visit the base's fire department to determine the status of emergency response services. This meeting will include a determination as to the need for further coordination with local rescue and police services.

Another aspect of preplanning for emergencies includes completion of the Medical Data Sheet (Section 14.1). This sheet must be completed by all SAIC personnel and subcontractors so that, in the event of personal injury or illness, the examining physician has background information readily available on the injured/ill party.

#### **13.2 EMERGENCY PROCEDURES AND ASSIGNMENTS**

Upon notification of a site emergency requiring evacuation, all SAIC personnel and subcontractors will proceed directly to the support zone (i.e., trailer, office). If personnel cannot reach the support zone without endangering life or health, an alternate meeting point will be specified by the SAIC SSO. Emergency egress routes and meeting points will be discussed at each health and safety briefing.

In the event of an emergency, the following procedures will be implemented:

- The site supervisor will evaluate the incident, assess the need for assistance, and call the appropriate contacts, if necessary.
- The site supervisor will act as the point of contact for outside emergency personnel and on-site personnel.
- The site supervisor will advise emergency response and emergency room personnel as to the types of contamination potentially contacted by injured workers receiving emergency care.
- The site supervisor will ensure that the SSO promptly notifies the SAIC PM and HSO of the incident.

### **13.2.1 Chemical Inhalation**

It is not anticipated that chemicals of concern will be present at the site in concentrations to cause immediate danger to life and health. However, any field personnel exhibiting or complaining of symptoms of chemical exposure as described in Section 4.1 will be removed from the work zone and transported to the designated medical facility for examination and treatment.

### **13.2.2 Eye and Skin Contact**

Field personnel who have come into contact with contaminants while in the exclusion zone will proceed immediately to the decontamination zone. Unless skin contact with contaminants is severe, personnel should proceed through the decontamination zone. Field personnel should remove any contaminated PPE and wash the affected area for at least 15 minutes. If the personnel show signs of skin irritation, they will be transported to the designated medical facility.

## **13.3 PROCEDURES FOR PERSONNEL REMAINING ON-SITE**

No SAIC or subcontractor personnel will remain on-site to perform critical site emergency operations.

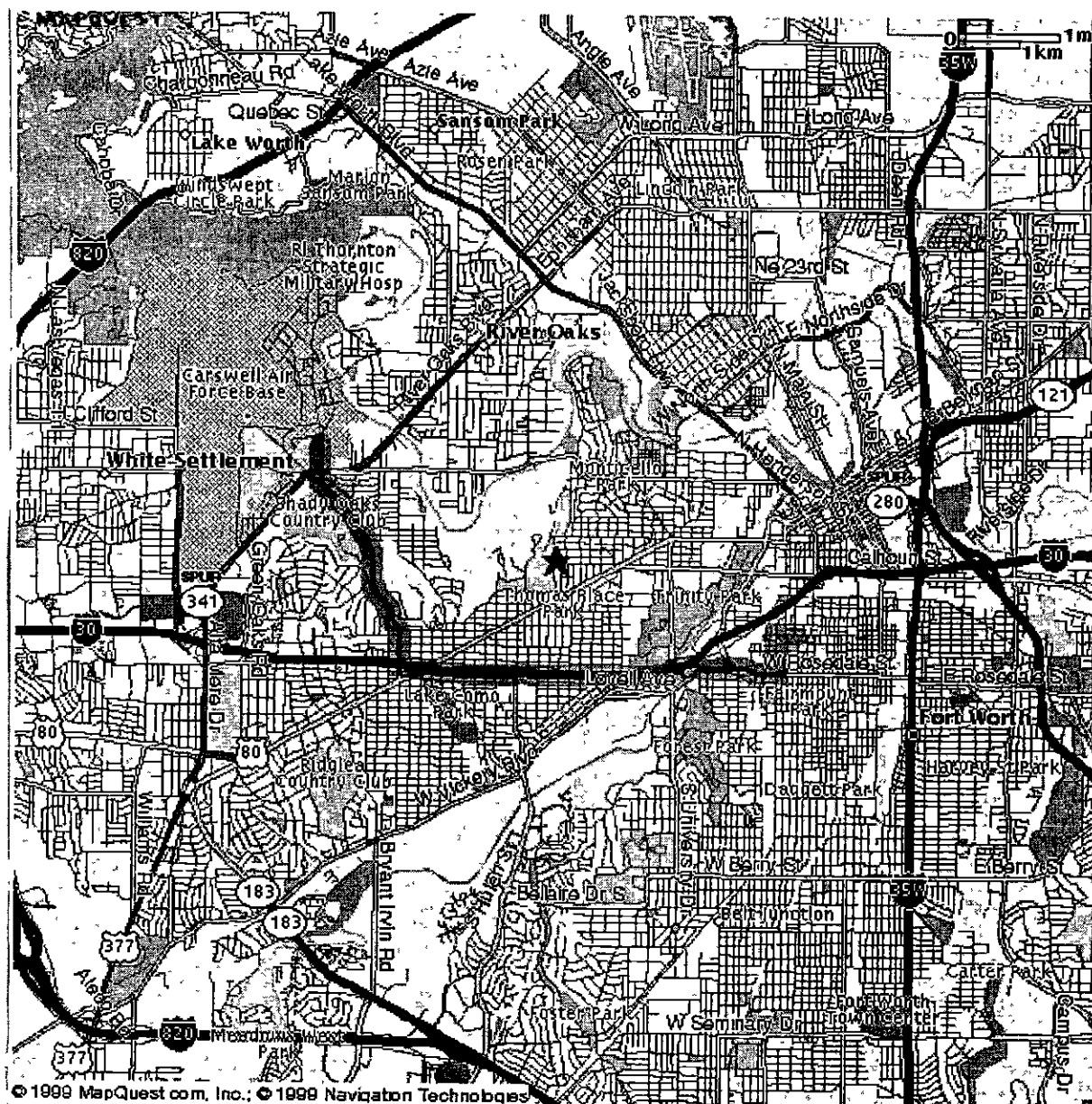
## **13.4 PROCEDURES TO ACCOUNT FOR SITE PERSONNEL**

The SAIC and subcontractor work force will be small enough so that accounting for site personnel will not be a problem. The SAIC field team leader and SSO will ensure that the whereabouts of all personnel are known.

## **13.5 RESCUE AND MEDICAL DUTIES**

Only those persons who have been trained by the American Red Cross, or equivalent, will be permitted to perform rescue, first aid, and/or CPR treatment. Outside emergency services and medical facilities will be the primary providers of such services. At least one person who is currently certified in first aid and CPR will be on-site at all times during field activities. A "physicians-approved" first-aid kit will be readily available on-site.

Any SAIC employee who shows signs or symptoms of overexposure must immediately be examined by a licensed physician. Subcontractor personnel who show signs or symptoms of overexposure will be encouraged to visit a licensed physician as well. Figure 13-1 describes the directions to the nearest medical facility.



**Figure 13-1**  
**Directions to Harris Hospital**

### **13.6 EMERGENCY COMMUNICATION PROCEDURES, CONTACTS, AND PHONE NUMBERS**

Persons who observe an emergency situation must immediately notify the SAIC field team leader and/or SSO. The field leader or SSO will then immediately assess the emergency and appoint someone to telephone appropriate outside emergency services and will coordinate site evacuation. Emergency telephone numbers and directions to the nearest medical facility are included as Table 13-1, a copy of which will be posted at the nearest telephone. In addition, Figure 13-1 illustrates the directions to the nearest medical facility.

**Table 13-1  
Emergency Telephone Numbers, Contacts, and  
Directions to Nearest Medical Facility**

<b>Key Personnel</b>	<b>Number</b>
Don Ficklen – Team Chief – HQ AFCEE/ERD	(210) 536-5290
Michael Dodyk – NAS Fort Worth JRB POC	(817) 782-7167
Robert Bauer, P.E. - Project Manager - SAIC	(210) 731-2202
Michael Holdsworth - Health and Safety Officer - SAIC	(210) 731-2283
David Dougherty - Program Manager - SAIC	(210) 731-2210
<b>Emergency Phones Numbers</b>	
Ambulance	911 or (817) 782-6330
Fire Department	911 or (817) 782-6330
Poison Control	911 or (800) 764-7661
Hospital - Harris Methodist - Fort Worth 1301 Pennsylvania Avenue	911 or (817) 882-2000
<b>Directions to Harris Hospital (Figure 13-1)</b>	
Exit NAS Fort Worth JRB on Pumphrey Rd. heading south. Turn left on Roaring Springs Rd. heading southeast for 2.0 miles. Roaring Springs Rd. turns into Horne St. prior to I-30. Turn left on I-30 heading east for 4.0 miles. Turn right on Summit Ave. heading south for 0.3 miles. Turn left on Pennsylvania Ave. heading east for 0.2 miles. Turn right on South Lake St. heading south to 1301 Pennsylvania Ave. Emergency entrance is located on the right.	

### **13.6.1 Accident/Incident Follow-Up and Reporting**

Upon receiving a report of an incident, the SSO shall immediately investigate the circumstances and make appropriate recommendations to prevent recurrence. The HSO shall also be immediately notified by telephone on occurrence of a serious accident or incident. The HSO, at their individual discretion, may also participate in the investigation.

Details of the incident shall be documented on the Accident/Incident/Near Miss Investigation form (Section 14.1) within 24 hours of the incident and shall be distributed to the PM, HSO, and COR. A copy of this report shall also be sent to the appropriate administrative contact for inclusion into the OSHA Form 101 and 200 log. Incident report forms will be available at site support facilities.

## **14. DOCUMENTATION AND EQUIPMENT**

This section summarizes the documentation and equipment needs for the project as specified in the HSP. Its purpose is to serve as a partial checklist to help ensure all of the necessary resources are available to carry out the requirements of the HSP.

### **14.1 DOCUMENTATION AND FORMS**

The following documents are presented in the following pages for use during site operations:

- Site Safety Briefing Form.
- HSP Compliance Agreement Form.
- HSP Amendments Form.
- Accident/Incident/Near Miss Investigation Form.
- Medical Data Sheet.
- Daily Equipment Calibration Log.
- Air Monitoring Log.

In addition, the following documentation will be present on-site during site operations:

- Approved HSP (signed copy).
- OSHA poster.
- MSDSs.
- Employee training and medical surveillance certificates.
- Subcontractor training and medical surveillance certificates.

### **14.2 EMERGENCY HEALTH AND SAFETY EQUIPMENT**

- First-aid kit
- Eye wash
- Inner latex or vinyl gloves
- Outer nitrile gloves (disposable and 11 mil thick)

- Boot covers
- Hard hats and safety glasses
- Tyvek suits
- PVC and/or Saranex suits (with hoods)
- Ear defenders/plugs
- Decontamination kit
- Fire extinguisher
- Fall protection devices (body harness and lanyard)
- Duct tape
- LEL/O<sub>2</sub> meter
- PID

The site supervisor and/or SSO shall be responsible for maintaining first aid kits and fire extinguishers at each site where field activities are taking place. The location of first aid kits and fire extinguishers will be discussed during each daily health and safety meeting.

## 15. REFERENCES

- A.T. Kearney. 1989. *RCRA Facility Assessment, Preliminary Review/Visual Site Inspection*.
- CH2M Hill. 1996. *Site Characterization Summary-Informal Technical Information Report*, NAS Fort Worth JRB, Carswell Field, Texas.
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**APPENDIX**  
**HEALTH AND SAFETY FORMS**

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**SITE SAFETY BRIEFING FORM**

Project \_\_\_\_\_

Date \_\_\_\_\_ Time \_\_\_\_\_

Location \_\_\_\_\_

Type of Work \_\_\_\_\_

**SAFETY TOPICS PRESENTED**Protective Clothing/Equipment  
\_\_\_\_\_  
\_\_\_\_\_Chemical Hazards  
\_\_\_\_\_  
\_\_\_\_\_Physical Hazards  
\_\_\_\_\_  
\_\_\_\_\_Emergency Procedures  
\_\_\_\_\_  
\_\_\_\_\_

Hospital/Clinic \_\_\_\_\_ Phone \_\_\_\_\_

Hospital Address \_\_\_\_\_

Special Equipment \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_Other  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**ATTENDEES**Name (Printed)Signature


Meeting Conducted by: \_\_\_\_\_

Site Safety Officer: \_\_\_\_\_

## HEALTH AND SAFETY PLAN COMPLIANCE AGREEMENT FORM

**PROJECT:** AOC 20 SI

**CLIENT:** U.S. Air Force Center for Environmental Excellence

**LOCATION:** NAS Fort Worth JRB, Texas

I, \_\_\_\_\_, have received a copy of the Health and Safety Plan for the above-referenced project. I have read the plan, understand it, and agree to comply with all its provisions. I understand that I can be prohibited from working on the project for violating any of the safety requirements specified in the plan.

Signed:

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Company

## HEALTH AND SAFETY PLAN AMENDMENT(S) FORM

Change in field activities or hazards: \_\_\_\_\_

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---

---

Proposed Amendment(s): \_\_\_\_\_

---

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---

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Proposed by: \_\_\_\_\_ Date: \_\_\_\_\_

Approved by: \_\_\_\_\_

Accepted: \_\_\_\_\_ Declined: \_\_\_\_\_ Date: \_\_\_\_\_

Amendment Number: \_\_\_\_\_

Amendment Effective Date: \_\_\_\_\_

**ACCIDENT/INCIDENT/NEAR MISS INVESTIGATION FORM**

Employee's Name: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

Job Title: \_\_\_\_\_ Supervisor's Name: \_\_\_\_\_

Office Location: \_\_\_\_\_

Location at Time of Incident: \_\_\_\_\_

Date/Time of Incident: \_\_\_\_\_

\_\_\_\_\_

Describe clearly how the accident occurred: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Was incident: Physical \_\_\_\_\_ Chemical \_\_\_\_\_

Parts of body affected \_\_\_\_\_ Exposure: Dermal \_\_\_\_\_

right \_\_\_\_\_ left \_\_\_\_\_ Inhalation \_\_\_\_\_

Ingestion \_\_\_\_\_

Witnesses: 1) \_\_\_\_\_ 2) \_\_\_\_\_

Conditions/acts contributing to this incident \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



**Managers must complete this section:**

Explain specifically the corrective action you have taken to prevent a recurrence:\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Did injured go to doctor:\_\_\_\_\_ Where:\_\_\_\_\_

\_\_\_\_\_ When:\_\_\_\_\_

Did injured go to hospital:\_\_\_\_\_ Where:\_\_\_\_\_

\_\_\_\_\_ When:\_\_\_\_\_

=====

**Signatures:**

_____	_____	_____
Employee Officer	Reporting Manager	Health & Safety

_____	_____	_____
Date	Date	Date

Accidents must be reported immediately; this form must be completed and returned to the Health and Safety Officer within **24 hours**.

**MEDICAL DATA SHEET**

This brief Medical Data Sheet will be completed by all onsite personnel and will be kept in the command post during the conduct of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project \_\_\_\_\_

Name \_\_\_\_\_ Home Telephone \_\_\_\_\_

Address \_\_\_\_\_

Age \_\_\_\_\_ Height \_\_\_\_\_ Weight \_\_\_\_\_

Name of Next of Kin \_\_\_\_\_

Drug or other Allergies \_\_\_\_\_

Particular Sensitivities \_\_\_\_\_

Do You Wear Contacts? \_\_\_\_\_

Provide a Checklist of Previous Illnesses or Exposure to Hazardous Chemicals.

\_\_\_\_\_

\_\_\_\_\_

What medications are you presently using? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Do you have any medical restrictions? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Name, Address, and Phone Number of personal physician: \_\_\_\_\_

---

---

---

---

---

I am the individual described above. I have read and understand this HSP:

---

---

---

Signature

---

Date

**DAILY EQUIPMENT CALIBRATION LOG**

Project Name:

<b>DATE/TIME</b>	<b>INITIALS</b>	<b>INSTRUMENT</b>	<b>CALIBRATION SOLUTION OR GAS CONCENTRATION</b>	<b>ADJUSTMENTS REQUIRED/ COMMENTS</b>

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**HEALTH AND SAFETY/AIR MONITORING LOG**

Date: \_\_\_\_\_ Logged by: \_\_\_\_\_

Weather: \_\_\_\_\_

Field Tasks: \_\_\_\_\_  
\_\_\_\_\_

SAIC Personnel (or subs) working on the site (name and affiliation):

SAIC Personnel (or subs) working in restricted zone:

SAIC Site Visitors:

Air Quality Monitoring Measurements:

<u>Time</u>	<u>Instrument</u>	<u>Parameter</u>	<u>Concentration</u>	<u>Locations</u>
-------------	-------------------	------------------	----------------------	------------------

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Background:

Exclusion zone:

Level of PPE: \_\_\_\_\_

Comments on other safety-related matters:

(including infractions, accidents, injuries, unusual occurrences, physical complaints)

# TAB

Field Sampling Plan.



**AOC 20 SITE INSPECTION  
NAS FORT WORTH JRB, TEXAS**

**FIELD SAMPLING PLAN**

**FINAL**

Prepared for

U.S. Air Force Center for Environmental Excellence  
Brooks AFB, Texas

Prepared by

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION  
San Antonio, Texas

Contract No. F41624-00-D-8030  
Delivery Order No. 0007

November 2000

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**Appendices**

FSP-A	Laboratory Quality Assurance Project Plan
FSP-B	Data Validation Forms

**ACRONYMS AND ABBREVIATIONS**

AFB	Air Force Base
AFCEE	U.S. Air Force Center for Environmental Excellence
AFP 4	Air Force Plant 4
AOC	area of concern
ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
COC	chain-of-custody
DO	dissolved oxygen
EC	electrical conductivity
ERPIMS	Environmental Restoration Program Information Management System
FSP	Field Sampling Plan
HSA	hollow stem auger
HSO	Health and Safety Officer
HSP	Health and Safety Plan
IDW	investigative derived waste
IRP	Installation Restoration Program
JRB	Joint Reserve Base
MS	matrix spike
MSD	matrix spike duplicate
NAS Fort Worth JRB	Naval Air Station Fort Worth Joint Reserve Base
NTU	nephelometric turbidity unit
ORP	oxidation-reduction potential
OVA	organic vapor analyzer
PID	photoionization detector
PM	Project Manager
POC	point of contact
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act

**ACRONYMS AND ABBREVIATIONS (cont.)**

SAC	Strategic Air Command
SC	specific conductivity
SI	site inspection
SVOC	semivolatile organic compound
TAC	Texas Administrative Code
TCE	trichloroethene
TNRCC	Texas Natural Resource Conservation Commission
TOC	total organic carbon
USAF	U.S. Air Force
USCS	United Soil Classification System
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

**Abbreviations**

3-D	three-dimensional
EC	degrees Celsius
L/min	liter per minute

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## 1. INTRODUCTION

The Field Sampling Plan (FSP) presents the requirements and procedures for conducting field operations and investigations. This project specific FSP has been prepared to ensure that (1) the data quality objectives specified for this project are met, (2) the field sampling protocols are documented and reviewed in a consistent manner, and (3) the data collected are scientifically valid and defensible. This site specific FSP and the Basewide Quality Assurance Project Plan (QAPP) (HydroGeoLogic Inc. 1998) shall constitute, by definition, the Sampling and Analysis Plan.

Guidelines followed in the preparation of this plan are set out in the U.S. Air Force Center for Environmental Excellence's (AFCEE) *Model Field Sampling Plan*, (AFCEE 1997) and the *Handbook for the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies* (AFCEE 1993).

This FSP is required reading for all staff participating in the work effort. The FSP shall be in the possession of the field teams during sample collection. The contractor and all subcontractors shall be required to comply with the procedures documented in this FSP in order to maintain comparability and representativeness of the collected and generated data.

Copies of this FSP shall be provided to applicable U.S. Air Force (USAF) managers, project managers (PMs), and quality assurance (QA) coordinators. Whenever USAF revisions are made or addenda added to the FSP, a document control system shall be put into place to ensure that (1) all parties holding a controlled copy of the FSP shall receive the revisions/addenda, and (2) outdated material is removed from circulation. The document control system does not preclude making and using copies of the FSP; however, the holders of controlled copies are responsible for distributing additional material to update any copies within their organizations. The distribution list for controlled copies shall be maintained by the contractor.

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## **2. PROJECT BACKGROUND**

The following sections briefly describe the project objectives and present site descriptions for this FSP.

### **2.1 SITE HISTORY**

In August 1942, the Air Force Base was opened as Tarrant Field Airdrome and was used to train pilots to fly B-24 Bombers under the jurisdiction of the Gulf Coast Army Air Field training Command. In May 1943, the field was redesignated as Fort Worth Army Air Field with continued use as a training facility for pilots. The Strategic Air Command (SAC) assumed control of the installation in 1946, and the base served as the headquarters for the Eighth Air Force. It was renamed Carswell Air Force Base (AFB) in 1948, and the 7<sup>th</sup> Bomber Wing became the base host unit. The Headquarters 19<sup>th</sup> Air Division was relocated to Carswell AFB in 1951, where it remained until September 1988 (Kearney 1989).

The SAC mission remained at Carswell AFB until 1992, when the Air Combat Command acquired the base upon disestablishment of SAC.

U.S. Air Force Plant 4 (AFP 4) was placed on the National Priorities List in August 1990 due to a large release of trichloroethene (TCE) arising from past disposal practices at AFP 4. The regional TCE plume is currently subdivided into northern and southern lobes. The northern lobe is migrating primarily eastward from the AFP 4 source area. The southern lobe is migrating southeast along a former paleochannel of the West Fork Trinity River.

On 1 October 1994, the Air Force transferred the majority of Carswell AFB to the U.S. Navy, now known as Naval Air Station Fort Worth Joint Reserve Base (NAS Fort Worth JRB), Carswell Field. NAS Fort Worth JRB is located on 2,264 acres of land in Tarrant County, Texas 8 miles west of downtown Fort Worth. The base is bordered to the north by Lake Worth, to the east, the West Fork of the Trinity River, River Oaks, and Westworth Village. Other urban areas of Fort Worth are located to the northeast and southeast; White Settlement to the west and southwest; and AFP 4 to the west. The area surrounding NAS Fort Worth JRB is mostly suburban. Land use in the immediate vicinity of the base is industrial, commercial, residential, and recreational.

### **2.2 PROJECT OBJECTIVES**

The overall objective of this Site Inspection (SI), and purpose of the field investigation, is to gather information to delineate the gravel channels (paleochannels) in the Walnut/Goodland bedrock confining layer and to determine preferential pathways for groundwater and associated TCE contamination between AFP 4 and NAS Fort Worth JRB, Texas, formerly Carswell AFB. The paleochannel(s) will be identified by determining the topography of the Walnut/Goodland aquitard and identifying the basal gravel portions of the terrace alluvial deposits overlying the bedrock.

In order to obtain the necessary data to complete the SI, the data collection efforts will consist of the following activities:

- Perform a 900 point seismic survey and two velocity surveys. The seismic survey will be calibrated against existing soil boring/monitoring well log data and velocity information to produce a conceptual site model, top of bedrock, basal gravel thickness, and TCE isopleth maps. These maps will be the basis for determining the location of a permeable reactive barrier planned to remediate TCE contaminated groundwater originating from AFP 4 (southern lobe regional TCE plume).
- Perform Electrical Imaging (EI) of four lines at 2,000 feet each for a total of 8,000 feet. The information collected from the EI will aid in the production of the conceptual site model.
- Install six soil borings to confirm the lithology and the channel location. Soil samples will be collected at the water level during the installation of each soil boring and be analyzed for volatile organic compounds (VOC) and total organic carbon (TOC).
- Install monitoring wells in five of the six soil borings for additional groundwater mapping.
- Collect groundwater samples from the five new and 10 existing monitoring wells for VOCs and natural attenuation parameters to map the groundwater plume. Three of the new wells will be sampled at three discrete intervals in the saturated zone.
- Survey along the seismic lines, electrical imaging lines, and the locations of the soil borings and monitoring wells.

## **2.3 PROJECT SITE DESCRIPTION**

The portion of the site covered by this FSP is located between AFP 4 and NAS Fort Worth JRB (see Figure 1-2, Work Plan). The site consists primarily of the flightline area. The area under investigation corresponds to the location of the southern lobe of the TCE Plume that originates primarily from AFP 4.

## **2.4 PROJECT SITE CONTAMINATION HISTORY**

Section 1.2 of the Work Plan provides the history of past work conducted at the site and documents contamination discovered. Please refer to this section for this information.

### 3. PROJECT SCOPE AND DATA QUALITY OBJECTIVES

The following sections describe the objectives of the SI and the specific field activities that will be conducted during the SI.

#### 3.1 DATA QUALITY OBJECTIVES

The data generated by this project must be of sufficient quality and quantity to support the overall project objective: delineation of the paleochannel(s) in the area of concern (AOC) 20.

Data from the following categories are required for the SI:

- Site Characterization - Data will be used to evaluate physical and chemical properties of soil, bedrock, and groundwater. The data will also be used to characterize the paleochannel(s) at the site.
- Health and Safety - Data will be used to establish the level of protection needed for the field sampling team and other site-related personnel. This data will be obtained from organic vapor analyzer (OVA) readings recorded during intrusive activities.
- SI data will be a combination of screening data and definitive data. Health and safety data will be collected as screening data. The definitions of screening data and definitive data, as established by the *Data Quality Objectives Process for Superfund Interim Final Guidance* (U.S. Environmental Protection Agency (USEPA)/540/G-93/071 1993), are described below:
- Screening Data with Definitive Confirmation - Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provides analyte identification and quantification. Although the quantification may be determined using analytical methods with QA/quality control (QC) procedures and criteria associated with definitive data, screening data without associated confirmation data are not considered to be data of known quality.
- Definitive Data - Definitive data will be generated using rigorous analytical methods, such as approved USEPA reference methods. Data will be analyte-specific, with confirmation of analyte identity and concentration. These methods produce tangible raw data (e.g., chromatograms, spectra, and digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined.

- The data generated by the laboratory analysis of samples must be sufficiently sensitive to allow comparison of the results. The *Basewide QAPP* (HydroGeoLogic 1998) describes each method that will be performed as part of the investigation and outlines the QA measures the contract laboratory must follow. The methods of analysis selected for samples collected from NAS Fort Worth JRB will produce screening as well as definitive data. Table 3-1 is a summary of the data quality levels and intended use for data collected during the SI.

**Table 3-1**  
**Data Quality Levels and Intended Use for Field and Laboratory Data**

Sampling Matrix	Parameters	Analytical Method	Field/Lab Analysis	Data Quality Level	Intended Use
Surface Soil	VOCs	PID	Field	Screening	Field screening for selecting samples for lab analysis
Subsurface Soil	VOCs	PID	Field	Screening	To differentiate stratigraphy
Soil	VOCs	8260B	Lab	Definitive	Nature/extent of contaminants
	Total Organic Carbon	SW9060	Lab	Definitive	Nature/extent of contaminants
Groundwater	VOCs	8260B	Lab	Definitive	Nature/extent of contaminants
	Alkalinity	SW310.1	Lab	Definitive	Natural attenuation potential
	Anions	SW9060	Lab	Definitive	Natural attenuation potential
	Ethane, Ethene, Methane	RSK-175	Lab	Definitive	Natural attenuation potential
	Total Organic Carbon				Natural attenuation potential
	Total Suspended Solids	E160.2	Lab	Definitive	Natural attenuation potential
	Arsenic	E160.2	Lab	Definitive	Natural attenuation potential
	Chloride	E160.2	Lab	Definitive	Natural attenuation potential
	VOCs	8260A	Lab	Definitive	Nature/extent of contaminants
	Total Suspended Solids	E160.2	Lab	Definitive	Water quality
	Arsenic	SW7060A	Lab	Definitive	Nature/extent of contaminants
	Chloride	SW9056	Lab	Definitive	Natural attenuation potential
	Nitrate	SW9056	Lab	Definitive	Natural attenuation potential
	Sulfate	SW9056	Lab	Definitive	Natural attenuation potential
	Alkalinity	SM2320	Lab	Definitive	Natural attenuation potential
	Ammonia	E350.1 or E350.3	Lab	Definitive	Natural attenuation potential
	Total Organic Carbon	SW9060	Lab	Definitive	Natural attenuation potential
	Ferrous Iron (Fe <sup>2+</sup> )	Colorimetric (Hach Kit)	Field Lab	Definitive	Natural attenuation potential
<b>Notes:</b> VOC volatile organic compound PID photoionization detector					

### 3.2 SAMPLE ANALYSIS SUMMARY

All soil samples collected as a part of the investigation will be analyzed for volatile organic compounds (VOC) by USEPA Method 8260B and TOC by USEPA Method 9060. All groundwater samples collected as a part of the investigation will be analyzed for VOCs by USEPA Method 8260B, TOC by USEPA Method 9060, and the set of natural attenuation parameters listed in Table 3-1.

### 3.3 FIELD ACTIVITIES

The following sections describe the proposed field investigation activities planned during this study. More detailed descriptions of the rationale and justification for each of the proposed activities are presented in Section 3 of the Work Plan.

The proposed field tasks described in this SI will be conducted to achieve the project objectives as presented in Section 2.2. SI activities will be conducted in the former Carswell AFB property. The site consists primarily of the flightline area. Table 3-2 provides a summary of the field activities and Table 3-3 presents the number of soil and groundwater samples to be collected and the analytical methods to be performed during the field investigation.

**Table 3-2**  
**Summary of Field Activities**

Seismic Survey	Electrical Imaging	Soil Borings	Monitoring Wells
900 points 2 velocity surveys	4 2,000-foot transects	6	5

#### 3.3.1 Geophysical Survey

A geophysical survey will be performed to delineate the gravel channels (paleochannels) in the Walnut/Goodland bedrock-confining layer. The geophysical survey will consist of a 900-point seismic survey with two velocity surveys of existing monitoring wells and four 2,000-foot electrical imaging lines.

#### 3.3.2 Soil Boring and Monitoring Well Installation

Six soil borings will be installed within the geophysical survey area for confirmation of lithology and channel location. During installation of the soil borings, soil samples will be collected at the groundwater interface and analyzed for VOCs and TOC.

Five monitoring wells will be installed in five of the six soil borings boreholes. The monitoring wells will be installed as two-inch polyvinyl chloride (PVC), flush mounted wells, screened across the saturated zone, and set at bedrock. The wells will be developed after installation, then purged and sampled (low flow) for VOCs in groundwater by Method 8260B and natural attenuation parameters. Three of the new five wells will be sampled at three discrete intervals in the saturated zone. All drilling, soil screening, and sample collection activities will be performed in accordance with Sections 5.0, 6.0, and 7.0 of this FSP.

**Table 3-3**  
**Sample Quantities, Analytical Parameters, and Methods**

Parameter/ Method	Matrix	Number of Samples	QA/QC Samples	Container	Preservative	Holding Time
VOCs SW8260A	soil	6	8	Pre-tered 3-40 ml glass vials with stir bars	Cool to 4°C	14 days (if frozen)
Total Organic Carbon SW9060	soil	6	8	4-oz jar	Cool to 4°C	28 days
VOCs SW8260A	water	21	11	3-40 ml glass vials with Teflon™ lined lid	HCl to pH <2 cool to 4°C	14 days
Total Suspended Solids E160.2	water	21	11	100 ml plastic/glass bottle	Cool to 4°C	7 days
Arsenic SW7060A	water	21	11	100 ml plastic/glass bottle	HNO <sub>3</sub> to pH <2	180 days
Chloride SW9056	water	21	11	250 ml glass/plastic bottle	Cool to 4°C	28 days
Methane, ethane, ethene Campbell et al , 1989 and 1998 headspace analysis	water	21	11	3 X 50 ml glass /plastic container with Teflon-lined septa and crimp caps	H <sub>2</sub> SO <sub>4</sub> to pH <2 cool to 4°C	28 days
Nitrate SW9056	water	21	11	250 ml glass/plastic container	H <sub>2</sub> SO <sub>4</sub> to pH <2 cool to 4°C	28 days
Sulfate SW9056	water	21	11	250 ml glass/plastic container	Cool to 4°C	28 days
Alkalinity SM2320	water	21	11	100 ml glass container	Cool to 4°C	14 days
Ammonia E350.1 or E350.3	water	21	11	100 ml glass/plastic container	H <sub>2</sub> SO <sub>4</sub> to pH <2 cool to 4°C	28 days
Total Organic Carbon SW9060	water	21	11	250 ml glass/plastic container	Cool to 4°C	28 days
<b>Notes:</b> Field Parameters (pH, DO, oxidation reduction potential, specific conductivity, and temperature) will be measured by Horiba U-22 water quality meter. Ferrous iron will be measured colorimetrically, using HACH Fe <sup>2+</sup> kit. °C      degrees Celsius HCl      hydrochloric acid HNO <sub>3</sub> nitric acid H <sub>2</sub> SO <sub>4</sub> sulfuric acid ml        milliliter oz        ounce VOC      volatile organic compound						



## **4. PROJECT ORGANIZATION AND RESPONSIBILITY**

Figure 4-1 shows the project organization, reporting relationships, and lines of authority. Table 4-1 lists essential project personnel and their respective telephone numbers. Other personnel will be assigned as necessary. The specific responsibilities are described in the following subsections.

### **4.1 MANAGEMENT RESPONSIBILITIES**

#### **4.1.1 Program Manager**

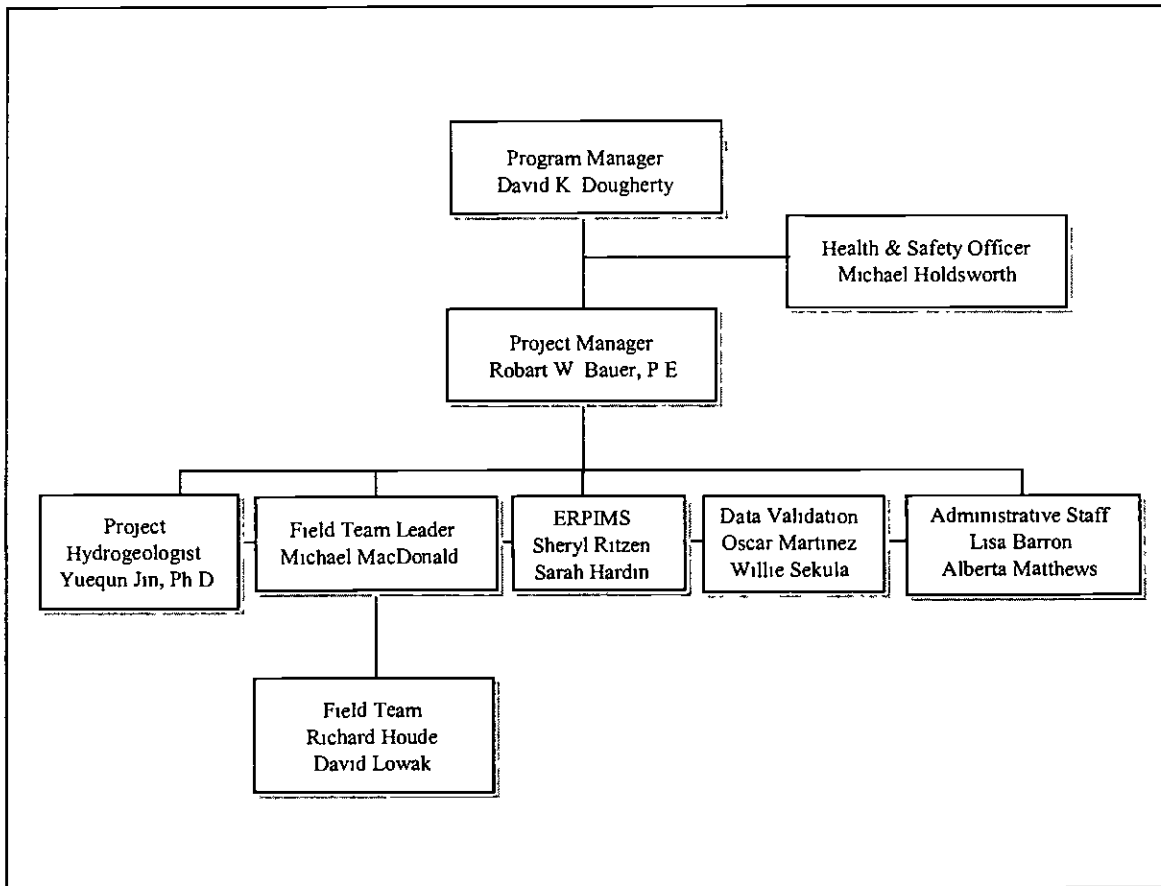
The Program Manager's responsibilities will include the following:

- Reviewing and approving the Work Plan, FSP, and Health and Safety Plan (HSP)
- Providing sufficient resources to the project team so that it can respond fully to the requirements of the investigation
- Providing direction and guidance to the PM
- Reviewing the final project report
- Providing other responsibilities as requested by the PM

#### **4.1.2 Project Manager**

The PM will be the prime point of contact with AFCEE and will have primary responsibility for technical, budget, and scheduling matters. PM duties will include:

- Reviewing and approving project plans and reports
- Assigning duties to the project staff and orienting the staff to the needs and requirements of the project
- Obtaining the approval of the QA Manager for proposed variances to the Work Plan and FSP
- Supervising the performance of project team members
- Providing budget and schedule control
- Reviewing subcontractor work and approving subcontract invoices
- Ensuring that major project deliverables are reviewed for technical accuracy and completeness before their release, including data validity
- Ensuring that all resources of the laboratory are available on an as-required basis
- Overseeing final analytical reports



**Figure 4-1**  
**SAIC Project Organization Chart**

**Table 4-1**  
**Key Project Personnel**

Name	Title	Organization	Telephone
Don Ficklen	Team Chief	AFCEE/ERD	(210) 536-5290
Michael Dodyk	NAS Fort Worth JRB POC	AFCEE/ERD	(817) 782-7167
David K. Dougherty	Program Manager	SAIC	(210) 731-2210
Robert W. Bauer, P.E.	Project Manager	SAIC	(210) 731-2202
Michael MacDonald	Field Team Leader	SAIC	(210) 731-2282
Oscar Martinez	Data Validation	SAIC	(210) 731-2239
Michael Holdsworth	Health & Safety Officer	SAIC	(210) 731-2283
Shawn Sunquist	Lab Project Manager	PDP	(281) 373-2233
TBD	Lab Operations Manager	TBD	TBD
TBD	Lab QA Officer	TBD	TBD
TBD	Lab Sample Custodian	TBD	TBD
Yuequn Jin, Ph.D.	Project Hydrogeologist	SAIC	(210) 731-2291
Notes			
TBD To Be Determined			

## **4.2 QA AND HEALTH AND SAFETY RESPONSIBILITIES**

### **4.2.1 QA Manager**

Responsibilities of the QA Manager will include:

- Serving as official contact for QA matters for the project
- Identifying and responding to QA/QC needs and problem resolution needs
- Answering requests for guidance or assistance
- Reviewing, evaluating, and approving the FSP and QAPP and all changes to these documents
- Verifying that appropriate corrective actions are taken for all nonconformances
- Verifying that appropriate methods are specified in the FSP for obtaining data of known quality and integrity
- Fulfilling other responsibilities as requested by the PM
- Evaluating subcontractor quality program
- Training staff on QA subjects
- Supervising staff in QA Program related tasks
- Recommending changes in the QA Program

### **4.2.2 Health and Safety Officer**

Responsibilities of the Health and Safety Officer (HSO) will include:

- Reviewing the HSP
- Ensuring that the requirements of the QAPP are satisfied
- Providing other responsibilities as identified in the HSP

## **4.3 LABORATORY RESPONSIBILITIES**

### **4.3.1 Laboratory Project Manager**

The laboratory's PM will report directly to SAIC's PM and will be responsible for the following:

- Ensuring that all resources of the laboratory are available on an as-required basis
- Overseeing final analytical reports

#### **4.3.2 Laboratory Operations Manager**

The laboratory's Operation Manager will report to the laboratory's PM and will be responsible for the following:

- Coordinating laboratory analyses
- Supervising in-house chain-of-custody (COC)
- Scheduling sample analyses
- Overseeing data review
- Overseeing preparation of analytical reports
- Approving final analytical reports prior to submission to SAIC

#### **4.3.3 Laboratory QA Officer**

The laboratory's QA officer has the overall responsibility for data after it leaves the laboratory. The QA officer will be independent of the laboratory but will communicate data issues through the laboratory's PM. In addition, the QA officer will be responsible for the following:

- Conduct audits of laboratory analyses
- Provide oversight of laboratory QA
- Provide oversight of QA/QC documentation
- Conduct detailed reviews of data
- Determine whether to implement laboratory corrective actions, if required
- Define appropriate laboratory QA procedures
- Prepare laboratory Standard Operation Procedures

#### **4.3.4 Laboratory Sample Custodian**

The laboratory's Sample Custodian will report to the Operations Manager. Responsibilities of the Sample Custodian will include:

- Receiving and inspecting the incoming sample containers
- Recording the condition of the incoming sample containers
- Signing appropriate documents
- Verifying COC and its correctness

- Notifying laboratory manager and laboratory supervisor of sample receipt and inspection
- Assigning a unique identification number and customer number, and entering each into the sample receiving log
- Initiating transfer of the samples to appropriate lab sections with the help of the laboratory operations manager
- Controlling and monitoring access/storage of samples and extracts

#### **4.4 FIELD RESPONSIBILITIES**

##### **4.4.1 Project Hydrogeologist**

The Project Hydrogeologist will be responsible for geologic interpretations as well as acting as lead coordinator for field activities. The Project Hydrogeologist's duties and responsibilities will include:

- Providing orientation and any necessary training to field personnel (including subcontractors) on the requirements of the FSP and HSP before the start of work
- Providing direction and supervision to the sampling crews
- Monitoring sampling operations to ensure that the sampling team members adhere to the FSP
- Ensuring the use of calibrated measurement and test equipment
- Maintaining a field records management system
- Coordinating activities with the PM
- Supervising geological data interpretation activities
- Overseeing field data documentation and conducting quality checks on interpretive geologic work products
- Reviewing reports for compliance with state of Texas and USEPA requirements
- Assuming the duties of the HSO if directed by the HSO

#### **4.5 SUBCONTRACTORS**

Subcontractors will be used for the laboratory analyses, drilling of soil borings, and monitoring well installations during the field investigation.

Qualified subcontractors will be selected in accordance with AFCEE requirements and SAIC procurement and QA procedures. Subcontractors will meet predetermined qualifications developed by the PM and defined in the procurement bid packages. Each bid submitted will be reviewed for technical, QA, and purchasing requirements. All subcontractors will be required to follow the procedures of the Work Plan, FSP, and HSP. Periodic QC inspections of each subcontractor may be performed as specified in the FSP (Section 7.4), Basewide QAPP (Section 9.1), and HSP (Section 1.3.2). These inspections will be performed by the QA Manager, or his designee, as unannounced audits to confirm adherence to the procedures and guidance outlined in the aforementioned documents. Such inspections may relate to health and safety, QAPP requirements, or field standard operating procedures.

## 5. FIELD OPERATIONS

The overall project field logistics and activities necessary to complete the project sampling objectives described in the Work Plan are presented in this section. All field work will be conducted in accordance with the site HSP. The point of contact (POC) at the base will be Mr. Michael Dodyk.

### 5.1 GEOLOGIC STANDARDS

The lithologic descriptions for consolidated materials (igneous, metamorphic, and sedimentary rocks) shall follow the standard professional nomenclature (cf. Tonnissen, A.C., 1983, *Nature of Earth Materials*, 2nd Edition, p. 204-348), with special attention given to describing fractures, vugs, solution cavities and their fillings or coatings, and any other characteristics affecting permeability. Colors shall be designated by the Munsell Color System.

The lithologic descriptions for unconsolidated materials (soils [engineering usage] or deposits) shall use the name of the predominant particle size (e.g., silt, fine sand, etc.). The dimensions of the predominant and secondary sizes shall be recorded using the metric system. The grain size and name of the deposit shall be accompanied by the predominant mineral content, accessory minerals, color, particle angularity, and any other characteristics. The classic deposit descriptions shall include, as a supplement, symbols of the Unified Soil Classification System (USCS). The color descriptions will be designated by the Munsell Color System.

Columnar sections, well and boring logs, well construction diagrams, cross sections, and three-dimensional (3-D) diagrams shall use standard patterns for the geologic units.

The scales for maps, cross sections, or 3-D diagrams shall be selected in accordance with the geologic and hydrologic complexity of the area and the purposes of the illustrations. Geophysical logs shall be run at a constant vertical scale of 1 inch equals 20 feet. When geophysical logs are superimposed on geologic logs, cross sections, or 3-D diagrams, the scales shall be the same. If defining geological conditions requires other scales, additional logs at those scales shall be provided.

For orientation, the cross sections shall show the northern end on the viewer's right. If the line of cross section is predominantly east-west, the eastern end is on the right. Maps shall be oriented with north toward the top, unless the shape of the area dictates otherwise. The orientation will be indicated with a north arrow.

## **5.2 SITE RECONNAISSANCE, PREPARATION, AND RESTORATION PROCEDURES**

Areas designated for intrusive sampling shall be surveyed for the presence of underground utilities. Utility locations are determined using existing utility maps and are verified in the field using a hand-held magnetometer or utility probe. Prior to commencement of electrical imaging and drilling activities, digging permits will be obtained from NAS Fort Worth JRB. The base civil engineer will be contacted to verify that selected locations are free of underground utilities. Those locations not clear of underground utilities will be repositioned within the marked area to a location a safe distance from the utilities, but suitable for the purpose of the investigation. Vehicle access routes to sampling locations shall be determined prior to any field activity.

A centralized decontamination area shall be provided for drilling rigs and equipment. The decontamination area shall be large enough to allow storage of cleaned equipment and materials prior to use, as well as to stage drums of decontamination waste. The decontamination area shall be lined with heavy gauge plastic sheeting, and designed with a collection system to capture decontamination waters. Solid wastes shall be accumulated in 55-gallon drums and subsequently transported to a waste storage area designated by the USAF. Smaller decontamination areas for personnel and portable equipment shall be provided as necessary. These locations shall include basins or tubs to capture decontamination fluids, which shall be transferred to a large accumulation tank as necessary. These designated areas of decontamination shall be determined during the pre-construction meeting. The field office and the primary staging area for field equipment and supplies will be located at the IDW Yard.

Each work site or sampling location shall be returned to its original condition when possible. Efforts shall be made to minimize impacts to work sites and sampling locations, particularly those in or near sensitive environments such as wetlands. Following the completion of work at a site, all drums, trash, and other waste shall be removed. Decontamination and/or rinse water and soil cuttings shall be transported to the designated locations as described in Section 5.9. At the completion of field activities, all capital equipment and consumable materials will be removed or turned over to base personnel in accordance with AFCEE procedures. A final site walk will be conducted with the base representative, at his/her discretion, to ensure that all sampling locations have been restored satisfactorily before final demobilization from the site.

## **5.3 BOREHOLE DRILLING, LITHOLOGIC SAMPLING, LOGGING, AND ABANDONMENT**

### **5.3.1 General Drilling Procedures**

All drilling activities shall be performed by a professional well driller licensed by the state of Texas, shall conform to state and local regulations, and will be supervised by a



professional geologist or engineer. SAIC will obtain and pay for all permits, applications, and other documents required by state and local authorities.

The location of all borings will be coordinated, in writing, with the base civil engineer, or equivalent, before drilling commences. Soil borings through the Terrace Alluvium will be advanced using hollow stem auger (HSA) drilling techniques.

A log of drilling activities will be kept in a bound field notebook. Information in the log book will include location, time on site, personnel and equipment present, down time, materials used, samples collected, measurements taken, and any observations or information that would be necessary to reconstruct field activities at a later date.

SAIC will dispose of all trash, waste grout, cuttings, and drilling fluids as coordinated with the base civil engineer or NAS Fort Worth JRB representative.

### **5.3.2 Sampling and Logging**

The lithology in all boreholes and of all bedrock cores will be logged. The boring log form will be used for recording the lithologic logging information. Information on the boring log sheet includes the borehole location, drilling information, sampling information (such as sample intervals), recovery, blow counts (if applicable), and sample description information.

When installing borings using HSA, unconsolidated samples for lithologic description will be obtained continuously at 5-foot intervals using split spoon samplers and standard penetration tests. Lithologic descriptions of unconsolidated materials encountered in the boreholes will generally be described in accordance with American Society for Testing and Materials (ASTM) D-2488-90 *Standard Practice for Description and Identification of Soils* (Visual-Manual Procedure) (ASTM 1990). Descriptive information to be recorded in the field will include the following: (1) identification of the predominant particles: size and range of particle sizes, (2) percent of gravel, sand, fines, or all three, (3) description of grading and sorting of coarse particles, (4) particle angularity and shape, and (5) maximum particle size or dimension.

Plasticity of fines description include the following: (1) color, (2) moisture (dry, wet, or moist), (3) consistency of fine grained soils, (4) structure of consolidated materials, and (5) cementation (weak, moderate, or strong).

Identification of the USCS group symbol will be used. Additional information to be recorded includes the depth to the water table, caving or sloughing of the borehole, changes in drilling rate, depths of laboratory samples, presence of organic materials, presence of fractures or voids in consolidated materials, and other noteworthy observations or conditions, such as the locations of geologic boundaries.

Lithologic descriptions of consolidated materials encountered in the boreholes shall generally be described in accordance with Section 5.1. Consolidated samples for lithologic description shall be obtained as a continuous section comprising the total

drilled depth of the boring. Rock cores shall be stored in standard core boxes, and missing sections of core shall be replaced with spacers. The core sections will be marked to indicate their position in the core relative to depth and orientation (top/bottom).

All samples will be monitored with an OVA (e.g., photoionization detector [PID]). The samples shall be handled in such a way as to minimize the loss of volatiles; these procedures are described in Section 6.2. Cuttings will be examined for their hazardous characteristics. Materials suspected to be hazardous because of abnormal color, odor, or OVA readings will be containerized in conformance with Resource Conservation and Recovery Act (RCRA), state, and local requirements.

### **5.3.3 Abandonment**

Boreholes that are not completed as monitoring wells shall be abandoned in accordance with 30 Texas Administrative Code (TAC) Chapter 238, *Water Well Driller Rules* (Texas Natural Resource Conservation Commission [TNRCC] 1997). Since the borings will not exceed 100 feet, the boring will be plugged to the ground surface with a solid column of 3/8 inch or larger granular sodium bentonite. The granular bentonite shall be hydrated at frequent intervals while strictly adhering to the manufacturer's specifications (TNRCC 1997).

All abandoned boreholes will be checked 24 to 48 hours after mud/solid bentonite emplacement to determine whether curing is occurring properly. More specific curing specifications may be recommended by the manufacturer and will be followed. If settling has occurred, a sufficient amount of bentonite will be added to fill the hole to the ground surface. Curing checks and any addition of bentonite will be recorded in the field log.

## **5.4 MONITORING WELL CONSTRUCTION**

The on-site geologist will supervise the drilling, soil boring, geophysical surveys, lithologic sampling, and monitoring well construction. Light non-aqueous phase liquids are not anticipated. Monitoring wells will be screened at the bottom of the aquifer to capture any dense petroleum products (i.e., dense non-aqueous phase liquids) if encountered.

### **5.4.1 Drilling Requirements**

All drilling and well installations will conform to state and local regulations, and SAIC will obtain and pay for all permits, applications, utility clearances, and other documents required by state and local authorities. The location of all borings will be coordinated in writing with the Base Public Work Officer, or equivalent, before drilling commences.

The HSA rig to be used will be cleaned and decontaminated according to the guidelines described in Section 5.9. The rig will not leak any fluids that may enter the borehole or

contaminate equipment that is placed in the hole. Rags or absorbent materials will not be used to absorb leaking fluids.

SAIC and its drilling subcontractors will dispose of all trash, waste grout, cuttings, and drilling fluids as coordinated with the base civil engineer or representative. Monitoring wells will be completed in the alluvial terrace groundwater only, thereby preventing cross-connection or cross-contamination of other water bearing zones or aquifers.

#### **5.4.2 Monitoring Well Borehole Requirements**

HSA drilling is to be used to install the monitoring wells during this project. The inside diameter of the borings will be at least 4 inches larger than the outside diameter of the casing and well screen. The total outside diameter of the boring will not exceed 6 inches. The wells will be installed three feet into bedrock and screened across the entire saturated thickness to 3 feet above the water table.

The completed monitoring wells will be sufficiently straight to allow passage of pumps or sampling devices and will be plumb within 1 degree of vertical where the water level is greater than 30 feet below land surface, unless otherwise approved by AFCEE. AFCEE may waive a plumbness requirement. Any request for a waiver from straightness or plumbness specifications will be made in writing to AFCEE, in advance of mobilization for drilling. SAIC or its drilling subcontractor will use a single-shot declination tool to demonstrate plumbness. Monitoring wells not meeting straightness or plumbness specifications will be redrilled and/or reconstructed.

The documentation record and forms (Attachment B) will document the following information for each boring: (1) boring or well identification (this identification shall be unique, and SAIC will ensure it has not been used previously at the installation), (2) purpose of the boring (e.g., soil sampling, monitoring well), (3) location in relation to an easily identifiable landmark, (4) names of drilling contractor and logger, (5) start and finish dates and times, (6) drilling method, (7) types of drilling fluids and depths at which they were used, (8) diameters of surface casing, casing type, and methods of installation, (9) depth at which saturated conditions were first encountered, (10) lithologic descriptions and depths of lithologic boundaries, (11) sampling-interval depths, (12) zones of caving or heaving, (13) drilling rate, and (14) drilling rig reactions, such as chatter, rod drops, and bouncing.

In addition to the above, the following information shall be recorded when rock core samples are collected: (1) the depth interval and top and bottom of each core shall be marked on the core box, (2) percentage of core recovered, (3) number of fractures per foot, (4) angle of fractures relative to the core axis, and (5) breaks due to coring and core handling shall be distinguished from naturally occurring fractures.

A standard penetration test shall be performed each time a split spoon sample is taken. The test shall be performed in accordance with ASTM D-1586.

#### **5.4.3 Casing Requirements**

The casing requirements that will be followed are the following: (1) all casing will be new, unused, and decontaminated according to the specifications of Section 5.8, (2) glue will not be used to join casing, and casings will be joined only with compatible welds or couplings that shall not interfere with the planned use of the well, (3) all PVC will conform to the ASTM Standard F-480-88A or the National Sanitation Foundation Standard 14 (Plastic Pipe System), (4) the casing will be straight and plumb within the tolerance stated for the borehole, and (5) the driller shall cut a notch in the top of the casing to be used as a measuring point for water levels.

All monitoring wells for this project will be constructed using flush threaded 2-inch diameter Schedule 40 PVC casing. The notches cut in the top of the monitoring well casings for water level measuring points will be oriented on the north side of each casing for uniformity.

#### **5.4.4 Well Screen Requirements**

AFCEE well screen requirements are the following: (1) all requirements that apply to casing will also apply to well screen, except for strength requirements, (2) monitoring wells will not be screened across more than one water-bearing unit, (3) screens will be factory slotted or wrapped, (4) screen slots will be sized to prevent 90 percent of the filter pack from entering the well, and (5) the bottom of the screen is to be capped, and the cap will be joined to the screen by threads. The monitoring wells will be constructed using flush-threaded 2-inch diameter Schedule 40 PVC casing and screen.

#### **5.4.5 Annular Space Requirements**

The annular space requirements are the following: (1) the annular space will be filled with a filter pack, a bentonite seal, and casing grout between the well string and the borehole wall, and (2) as the annular space is being filled, the well string will be centered and suspended such that it does not rest on the bottom of the hole, and for wells greater than 50 feet deep, at least two stainless steel centralizers will be used, one at the bottom and one at the top of the screen. Additional centralizers will be used as needed.

#### **5.4.6 Filter Pack Requirements**

The filter pack will consist of silica sand or gravel and will extend from the bottom of the hole to at least 2 feet above the top of the well screen. After the filter pack settles, the top of the sand pack will be sounded to verify its depth during placement. Additional filter pack will be emplaced as required to return the level of the pack to 2 feet above the screen.

The filter pack material will be clean, inert, and well-rounded and will contain less than two percent flat particles. The sand will be certified free of contaminants by vendor or contractor. If decontamination is necessary, the methods shall be approved in writing by

AFCEE. The grain size of the filter pack material will be determined based on existing grain size analysis prior to mobilization to the field. The filter pack will have a grain size distribution and uniformity coefficient compatible with the formation materials and the screen. This will be calculated as described in Chapter 12, *Ground Water and Wells*, 2<sup>nd</sup> Edition (Driscoll 1986). Filter packs for the paleochannel wells will use silica sand or pea-gravel that has a hydraulic conductivity that is at least twice as high as hydraulic conductivity values measured during previous aquifer tests conducted in the Terrace Alluvium. To ensure that this condition is met, the grain size distribution of the filter pack material will be used to calculate an effective hydraulic conductivity using the Hazen (1893) and/or Masch and Denny (1966) approximations. The estimated hydraulic conductivities associated with the filter pack material will be compared to hydraulic conductivities measured in the alluvial sediments.

The filter pack will not extend across more than one water-bearing unit. In all wells (deep or shallow), the filter pack will be emplaced with a bottom discharge tremie pipe of at least 10 inches in diameter to prevent bridging. The tremie pipe will be lifted from the bottom of the hole at the same rate the filter pack is set. SAIC will record the volume of the filter pack emplaced in the well. If potable water is necessary to place the filter pack, SAIC will obtain prior approval from the regulatory agency providing oversight, and will ensure that no contaminants are introduced into the well.

#### **5.4.7 Bentonite Seal Requirements**

The bentonite seal requirements that will be followed are the following: (1) the bentonite seal will consist of at least 2 feet of bentonite between the filter pack and the casing grout, (2) the bentonite will be hydrated before placement and shall be installed by pump tremie methods, and (3) only 100 percent sodium bentonite shall be used.

#### **5.4.8 Casing Grout Requirements**

The casing grout requirements are the following: (1) the casing grout will extend from the top of the bentonite seal to ground surface, (2) the grout will be mixed in the following proportions: 94 pounds of neat Type I Portland or American Petroleum Institute Class A cement, not more than 4 pounds of 100 percent sodium bentonite powder, and not more than 8 gallons of potable water, (3) all grout will be pump tremied using a side-discharge tremie pipe, and pumping will continue until 20 percent of the grout has been returned to the surface, and (4) in wells where the bentonite seal is visible and within 30 feet of the land surface, the 20 percent return is not necessary so long as the tremie pipe is pulled back as the grout is emplaced.

#### **5.4.9 Surface Completion Requirements**

For flush-mounted completions (the paleochannel wells and other wells designated by the base POC), the casing will be cut about three inches below the land surface and provide a water-tight casing cap to prevent surface water from entering the well. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole will be placed in the upper portion of the casing, or a ventilated well cap will be used. A freely draining valve box with a

locking cover will be placed over the casing. The top of the casing will be at least one foot above the bottom of the box. The valve box lid will be centered in a 3-foot diameter, four-inch thick concrete pad that slopes at a one to three percent grade away from the box at  $\frac{1}{4}$  inch per foot. The identity of the well will be permanently marked on the valve box lid and the casing cap. Where heavy traffic may pass over the well or for other reasons, the concrete pad and valve box/lid assembly will be constructed to meet the strength requirements of surrounding surfaces.

When aboveground surface completion is used, the well casing will be extended 2 or 3 feet above land surface. A casing cap will be provided for each well, and the extended casing will be shielded with a steel sleeve that is placed over the casing and cap and seated in a 3- by 3-foot by 4-inch concrete surface pad. To allow for escape of gas, a small diameter (e.g.,  $\frac{1}{4}$ -inch) vent hole will be placed in the well casing, or a ventilated well cap will be used. The concrete surface pad will be reinforced with steel reinforcing bars at least  $\frac{1}{4}$ -inch in diameter. The ground surface will be freed of grass and scoured to a depth of 2 inches before setting the concrete pad. The diameter of the sleeve will be at least 6 inches greater than the diameter of the casing. The pad will be sloped away from the well sleeve. A lockable cap or lid will be installed on the guard pipe. The identity of the well will be permanently marked on the casing cap and the protective sleeve. Three 3-inch diameter concrete-filled steel guard posts, each 5 feet in total length, will be installed radially from each well head. The guard posts will be recessed approximately 2 feet into the ground and set in concrete. The guard posts will not be installed in the concrete pad placed at the well base. The protective sleeve and guard posts will be painted with a color specified by the installation civil engineer.

All wells will be secured as soon as possible after drilling with COC seals for both flush and above-ground surface completions. The seal number for each well will be recorded in the field notebook. A Monitoring Well Construction Form will be completed for each well. Examples of field forms are presented in Attachment B.

## 5.5 MONITORING WELL DEVELOPMENT

The monitoring well development requirements are the following: (1) all newly installed monitoring wells will be developed no sooner than 24 hours after installation to allow for grout curing, (2) all drilling fluids used during well construction will be removed during development, (3) wells will be developed using surge blocks and bailers or pumps (prior approval for any alternate method will be obtained, in writing, from AFCEE before well construction begins), and wells will be developed until the turbidity of the well is less than or equal to 10 nephelometric turbidity units (NTU) and remains within a 5 NTU range for at least 30 minutes and the stabilization criteria in Section 6.1 are met, (4) discharge water color and volume will be documented, (5) no sediment will remain in the bottom of the well, (6) no detergents, soaps, acids, bleaches, or other additives will be used to develop a well, and (7) all development equipment will be decontaminated according to the specifications of Section 5.9.

## 5.6 ABANDONING MONITORING WELLS

All abandonment of monitoring wells, when necessary, shall be performed in accordance with state and local laws and regulations. If slurry is used, a mud balance and/or Marsh Funnel will be used to ensure that the density (pounds per gallon) of the abandonment mud mixture conforms to the manufacturer's specification. All abandoned monitoring wells will be checked 24 to 48 hours after mud/solid bentonite emplacement to determine whether curing is occurring properly. More specific curing specifications or quality assurance checks may be recommended by the manufacturer and will be followed. Additionally, if significant settling has occurred, a sufficient amount of mud/solid bentonite will be added to attain its initial level. These mud/solid bentonite curing checks and any addition of mud/solid bentonite will be recorded in the field logs.

## 5.7 SURVEYING

A State of Texas certified land surveyor will measure all field surveying locations. The surveys will be third order and references will be tied to the Texas State Plane Coordinate System (cf. Urquhart, L.C., *1962 Civil Engineering Handbook*, 4th Edition, p. 96 and 97). All surveyed locations will be reported using the Texas State Plane Coordinate System, North Central Zone. The horizontal datum will be the North American Datum of 1983 and the units will be in U.S. Survey feet. The vertical datum will be the National Geodetic Vertical Datum of 1988 and the units will be in U.S. Survey feet. The surveyed control information for all data collection points will be recorded and displayed in a table. The table will give the northing (Y) and easting (X) coordinates; the ground elevation and the measuring point elevation if the location is a groundwater monitoring well. The reference location is the origin. The elevation of all newly installed wells will be surveyed at the water level measuring point (notch) on the riser pipe. The elevation of the ground surface at each water level measuring point will be included in the survey. The accuracy of the X-Y coordinates for each sample location will be accurate to within 0.1 feet.

## 5.8 EQUIPMENT DECONTAMINATION

All equipment that may directly or indirectly come in contact with samples will be decontaminated in a designated decontamination area. This includes casing, drill bits, auger flights, portions of drill rigs that stand above boreholes, sampling devices, and instruments, such as slugs and sounders. In addition, SAIC and its subcontractors will take care to prevent the sample from coming into contact with potentially contaminating substances such as tape, oil, engine exhaust, corroded surfaces, and dirt.

The following procedure will be used to decontaminate large pieces of equipment such as casings, auger flights, pipe and rods, and those portions of the drill rig that may stand directly over a boring or well location or that come into contact with casing, auger flights, pipe, or rods. The external surfaces of equipment will be washed with high-pressure

hot water and Alconox<sup>TM</sup>, or equivalent laboratory-grade detergent, and if necessary, scrubbed until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed. The equipment will then be rinsed with potable water. The inside surfaces of casing, drill rod, and auger flights will also be washed as described.

The following procedure will be used to decontaminate sampling and drilling devices such as split spoons and augers that can be hand-manipulated. For sampling and smaller drilling devices, the equipment will be scrubbed with a solution of potable water and Alconox<sup>TM</sup>, or equivalent laboratory-grade detergent. The equipment will then be rinsed with copious quantities of potable water followed by a rinse with ASTM Type II reagent-grade water. High pressure liquid chromatograph-grade water and distilled water purchased in stores are not acceptable substitutes for ASTM Type II Reagent-Grade Water. The equipment will then be rinsed with pesticide-grade methanol followed by a rinse with pesticide-grade hexane. The equipment will then be allowed to air dry on a clean surface or rack, such as Teflon<sup>TM</sup>, stainless steel, or oil-free aluminum, elevated at least 2 feet above ground. If the sampling device will not be used immediately after being decontaminated, it will be wrapped in oil-free aluminum foil, or placed in a closed container made of stainless steel, glass, or Teflon.

Reagent-Grade II water, methanol, and hexane will be purchased, stored, and dispensed only in glass, stainless steel, or Teflon containers. These containers will have Teflon caps or cap liners. SAIC and its subcontractors will assure that these materials remain free of contaminants. If any question of purity exists, new materials will be used.

All fluids generated during decontamination activities will be placed in United Nations approved steel 55-gallon drums. All drums will be properly labeled as to content and shall be staged in a central location designated by the base representative for temporary storage pending removal and disposal.

## 5.9 WASTE HANDLING

Waste handling will be dealt with on a site-by-site basis. Waste will be classified as either non-investigative derived waste or investigative derived waste (IDW) per the requirements of 30 TAC §335 Subchapter R and 40 Code of Federal Regulations (CFR) Part 261, Subpart C. Non-investigative derived waste, such as litter and household garbage, will be collected on an as needed basis to maintain each site in a clean and orderly manner. This waste will be containerized and transported to the designated sanitary landfill or collection bin. Acceptable containers will be sealed boxes or plastic garbage bags. Waste containers will be labeled with the following information: type of matrix being contained, depth from which matrix was obtained, date matrix was contained, company name and telephone number, and whether matrix is considered hazardous or not.

Characterization of IDW will be based on sample analysis obtained during the field investigation following USEPA approved methods. Hazardous waste classification will



first be determined as per 40 CFR §261.2, §261.3, or §261.4. Waste that is non-hazardous, is then classified as Class 1, Class 2, or Class 3 according to 30 TAC §335.505 - 335.507. Once the IDW has been characterized, an eight-digit waste code number will be provided as required in §335.501. The disposal of IDW will be conducted in a timely and cost effective manner, and in accordance with all state and federal regulations.

IDW will be properly containerized and temporarily stored at each site, prior to transportation. Depending on the constituents of concern, fencing or other special markings may be required. The number of containers will be estimated on an as-needed basis. Acceptable containers will be sealed in either 55-gallon drums or small dumping bins with lids. The containers will be transported in such a manner to prevent spillage or particulate loss to the atmosphere.

The IDW will be segregated at the site according to matrix (solid or liquid) and as to how it was derived (drill cuttings, drilling fluid, decontamination fluids, and purged groundwater). Each container will be properly labeled with site identification, sampling point, date, depth, matrix, constituents of concern, and other pertinent information for handling.

Waste generated during the field activities will be handled and disposed of in accordance with applicable federal, state, and local regulations. Disposable materials such as latex gloves, aluminum foil, paper towels, etc., will be placed and sealed in plastic garbage bags for disposal with sanitary waste from the site. Soil cuttings will be placed in 55-gallon steel open top drums with lids. Development and purge waters evacuated from groundwater monitoring wells, and all fluids generated during decontamination activities will be placed in 55-gallon steel drums or equivalent. Drums will be properly labeled with the appropriate boring or well number, and content, and will be staged in a central location designated by the base representative for temporary storage pending removal and disposal.

## **5.10 CORRECTIVE ACTION**

Table 5-1 contains a summary of field QC procedures and corrective actions.

**Table 5-1**  
**Field Corrective Action Procedures**

Situation	Calibration	Frequency	Field Objective Affected	Corrective Action Procedure
Equipment malfunction			Equipment is calibrated and operating properly	<ul style="list-style-type: none"> <li>• Notification of site supervisory personnel</li> </ul>
PID/OVA	Calibrated to 20% of known calibration gas	Daily		<ul style="list-style-type: none"> <li>• Correct problem, recalibrate</li> </ul>
pH	Calibrated with two buffer solutions that bracket expected sample pH	Daily		<ul style="list-style-type: none"> <li>• Repair or replace malfunctioning parts</li> </ul>
SC	Calibrated with two standards in expected range of sample SC	Daily		<ul style="list-style-type: none"> <li>• Recalibrate and/or replace standards</li> </ul>
Temperature	Calibrate within expected temperature range of samples	Daily		<ul style="list-style-type: none"> <li>• Repair or replace malfunctioning parts</li> </ul>
Turbidity	Calibrate within expected range of sample turbidity	Monthly  Daily		<ul style="list-style-type: none"> <li>• Submission of document to Project Geologist, Project Manager, and Quality Assurance Manager</li> </ul>
Incorrect sample collection procedures	NA	NA	Samples are taken according to standard operating procedures	<ul style="list-style-type: none"> <li>• Notification of site supervisory personnel</li> <li>• Review of situation and correct procedures</li> <li>• Submission of document to Project Geologist, Project Manager, and Quality Assurance Manager</li> </ul>

**Table 5-1**  
**Field Corrective Action Procedures (cont.)**

Situation	Calibration	Frequency	Field Objective Affected	Corrective Action Procedure
Insufficient sample volume collection	NA	NA	Sufficient sample volume is provided to maintain sample integrity so that all required analyses can be conducted	<ul style="list-style-type: none"> <li>• Notification of site supervisory personnel by laboratory manager</li> <li>• Review site affected and impact of samples on site characterization - correct procedures</li> <li>• Submission of document to Project Geologist, Project Manager, and Quality Assurance Manager</li> </ul>
Incorrect measurement data collection	NA	NA	Measurements are conducted according to standard operating procedures	<ul style="list-style-type: none"> <li>• Notification of site-supervisory personnel</li> <li>• Review of situation and correct procedures</li> <li>• Submission of document to Project Geologist, Project Manager, and Quality Assurance Management</li> </ul>
<b>Notes:</b> NA            Not Applicable PID/OVA    photoionization detect or organic vapor analyzer SC            specific conductivity				

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## **6. ENVIRONMENTAL SAMPLING**

### **6.1 SAMPLING PROCEDURES**

All purging and sampling equipment will be decontaminated according to the specifications in Sections 5.8 and 7.3 prior to any sampling activities and will be protected from contamination until ready for use. The construction material of the sampling devices (e.g., plastic, PVC, metal, etc.) discussed below will be appropriate for the contaminant of concern and will not interfere with the chemical analyses being performed.

#### **6.1.1 Groundwater Sampling**

When numerous monitoring wells are to be sampled in succession, wells expected to have low levels of contamination or no contamination will be sampled prior to wells expected to have higher levels of contamination. This practice will help reduce the potential for cross contamination between wells. All sampling activities will be recorded in the field log book. Additionally, all sampling data will be recorded on a Field Sampling Report form.

Before groundwater sampling begins, wells will be inspected for signs of tampering or other damage. If tampering is suspected, (i.e., casing is damaged, COC seal or cap is missing) this will be recorded in the field log book and on the well sampling form, and reported to the project geologist. Wells that are suspected to have been tampered with will not be sampled until the project geologist has discussed the matter with the PM.

Before the start of sampling activities, plastic sheeting will be placed on the ground adjacent to the well. The plastic sheeting will be used to provide a clean working area for clean equipment to be placed during sampling. Water will be removed from the protective casing or from vaults around the well casing prior to venting and purging. Every time a casing cap is removed to measure water level or collect a sample, the air in the breathing zone will be checked with an OVA. Procedures in the HSP will be followed when high concentrations of organic vapors are detected. Air monitoring data will be recorded on the well sampling form.

Purge pump intakes will be equipped with a positive check valve to prevent purged water from flowing back into the well. Purging and sampling will be performed in a manner that minimizes aeration in the well bore and the agitation of sediments in the well and formation. Equipment will not be allowed to free-fall into a well.

In addition to the information required in Section 8.0, the following information will be recorded each time a well is purged and sampled: (1) depth to water before and after purging; (2) sounded total depth of the monitoring well; (3) the condition of each well, including visual (mirror) survey; (4) the thickness of any nonaqueous layer and; (5) field parameters, such as pH, temperature, electrical conductivity (EC), oxidation-reduction

potential (ORP), dissolved oxygen (DO), and turbidity. This information will be encoded in the Environmental Restoration Program Information Management System (ERPIMS) files when required.

#### **6.1.1.1 Water Level Measurement**

An interface probe will be used to determine the presence of floating product, if any, prior to measurement of the groundwater level. The groundwater level will then be measured to the nearest 0.01 foot using the interface probe or an electric water level indicator. Water levels will be measured from the notch located at the top of the well casing and recorded on the well sampling form. If well casings are not notched, measurements will be taken from the north edge of the top of the well casing, and a notch will be made using a decontaminated metal file. The groundwater elevation (mean sea level) is calculated by subtracting the depth to the water from the top of the well casing elevation.

Following water level measurement, the total depth of the well from the top of the casing will be determined using a weighted tape or electric sounder and recorded on the well sampling form. The water level depth will then be subtracted from the total depth of the well to determine the height of the water column present in the well casing. All water level and total depth measuring devices will be routinely checked with a tape measure to ensure measurements are accurate.

#### **6.1.1.2 Purging Prior to Sampling**

Purging of monitoring wells is performed to evacuate water that has been stagnant in the well and may not be representative of the aquifer. Purging will be accomplished using the micropurge technique. Micropurge is a low flow-rate monitoring well purging and sampling method that induces laminar (non turbulent) flow in the immediate vicinity of the sampling pump intake, thus drawing groundwater directly from the sampled aquifer, horizontally through the well screen, and into the sampling device.

Pumps capable of achieving low flow rates in the range of 0.1 to 0.5 liters per minute (L/min) will be used for purging and sampling. These low flow rates minimize disturbance in the screened aquifer, resulting in the following: (1) minimal production of artificial turbidity and oxidation; (2) minimal mixing of chemically distinct zones; (3) minimal loss of VOCs; and (4) collection of representative samples while minimizing purge volume.

Pumps will be lowered to the middle of the screened interval or slightly above the interval (i.e., a measured depth of 43 percent of the saturated screened interval below the top of the water table). This is to minimize the re-suspension of solids which have collected at the bottom of the well and to minimize the potential mixing of stagnant water trapped in the casing above the screen. The goal is to minimize the disturbance of water and solids in the well casing.

As a guide to flow rate adjustment during purging, water levels will be checked and recorded to monitor drawdown in the well. Groundwater will be pumped in a manner which minimizes the stress to the system to the extent practical, taking into account established site sampling objectives. The goal is to purge the well at a rate that does not draw down the static water level more than 0.33 feet.

Temperature, pH, EC, DO, ORP, and turbidity will also be measured during purging and recorded on the well sampling form. Measurements will be taken every 3 to 5 minutes when flow rates are in the 0.1-0.5 L/min range. Stabilization is achieved after all parameters have stabilized for three consecutive readings. Successive readings should be approximately within  $\pm 1.0$  degrees Celsius ( $^{\circ}\text{C}$ ) for temperature,  $\pm 0.1$  units for pH,  $\pm 3$  percent for EC,  $\pm 0.1$  mg/L or 10 percent (whichever is greater) for DO,  $\pm 10$  percent for ORP, and  $\pm 10$  percent for turbidity. In general, the order of stabilization is pH, temperature, and EC, followed by ORP, DO, and turbidity. Turbidity readings below 10 NTUs are desired, especially when metal samples are to be collected. When turbidity is high, the purge time will be extended in order for turbidity to reach 10 NTUs; however, if turbidity stabilizes above 10 NTUs for 15-30 minutes, then turbidity will be considered stable as defined above.

Groundwater samples will be collected using the pump used in the purging procedure. If the parameters do not stabilize after one to two hours when the drawdown indicates a laminar flow, a subset (pH, EC, and turbidity or DO) will be used as the stabilization parameters. If subset parameters do not stabilize, then the sample will be collected when a maximum number of parameters stabilize, and the anomalous parameters will be brought to the Field Coordinator's attention. Water samples will be collected immediately after parameter stabilization using the same pump as was used in purging. Field equipment will be calibrated in accordance with the Basewide QAPP (HydroGeoLogic 1998), Section 6.0, and in Section 7.2 of this FSP.

If during low-flow purging the drawdown is greater than 0.33 feet, then the micropurge technique is assumed to be invalid and will be discontinued. When drawdown is greater than 0.33 feet groundwater flow to the pump is no longer considered to be laminar across the screen from the aquifer. The flow in the vicinity of the pump would then contain a vertical component from the stagnant water column in the filter pack and casing.

In this situation (i.e., drawdown  $> 0.33$  feet at low-flow rates), the drawdown will continue to be monitored and the pumping rate will be adjusted to avoid pumping the well dry. Measurements for water quality parameters will be taken every 3 to 5 minutes. After stabilization parameters are met, water samples will be collected when the water level has recovered to 80 percent of its static water level or 16 hours after completion of purging. Water samples will be collected using either a low-flow pump or a Teflon bailer.

If a well is purged dry, then the well will be sampled as soon as a sufficient volume of groundwater has entered the well to enable the collection of necessary groundwater

samples (USEPA 1992). Water samples will be collected using either a low-flow pump or a Teflon bailer.

Water removed from the well during purging will be containerized. Detailed information concerning IDW is presented in Section 5.10.

#### 6.1.1.3 Sample Collection

At newly developed wells, water samples may only be collected after a 24-hour period has elapsed from the conclusion of monitoring well development activities.

Following the micropurge techniques, or three well volume techniques outlined above, a bladder pump will be used to collect water samples. Samples to be analyzed for volatile or gaseous constituents will not be withdrawn with pumps or at flows that degas the samples. Water quality indicators will be monitored during micropurge (turbidity, DO, specific conductivity, temperature, etc.).

Groundwater samples will be collected after the critical water quality indicators have stabilized for three consecutive readings. Stabilization criteria are presented above in Section 6.1.1.2. Where possible, groundwater samples will be collected using the same pump used in the purging procedure. If the parameters do not stabilize, a subset (pH, EC, and turbidity or DO) will be used as the stabilization parameters. If subset parameters do not stabilize, then the sample shall be collected as described above in Section 6.1.1.2 and the anomalous parameters shall be brought to the Field Coordinator's attention. Field equipment will be calibrated in accordance with the *Basewide QAPP* (HydroGeoLogic 1998).

If not supplied by the laboratory in a pre-preserved state, the preservative hydrochloric acid shall be added to the VOC sample bottle before introducing the sample water. The sample shall be collected from the pump discharge line using a slow, controlled pour down the side of a tilted sample vial to minimize volatilization. The sample vial shall be filled until a meniscus is visible and immediately sealed. When the bottle is capped, it shall be inverted and gently tapped to ensure no air bubbles are present in the vial. If bubbles are present after the initial filling, the vials shall be discarded and the VOC sampling effort shall be repeated. Refilling of vials will result in loss of preservatives. After the containers are sealed, degassing may cause bubbles to form in the sample. These bubbles shall be left in the container. These samples shall never be composited, homogenized, or filtered.

Following the collection of VOC samples, the remaining water samples shall be collected in the following order (as needed): ethane, ethane, and methane; alkalinity; and common anions. Field filtering of metals will not occur.

Required sample containers, preservation methods, volumes, and holding times are given in Section 3.3 and Table 3-3. Sampling equipment shall be decontaminated in accordance with Section 5.8 upon completion of sampling activities.



### **6.1.2 Surface Soil Sampling**

Although surface soil sampling is not currently proposed, if field conditions warrant their collection the following procedures will be used.

Surface soil samples shall be collected from the land surface to two feet below the surface. The sample shall be homogenized and quartered before being containerized. Samples collected for VOC analysis shall be containerized in EnCore™ core samplers prior to sample homogenization. Stainless steel scoops or trowels, glass jars with Teflon lids or equivalent equipment compatible with the chemical analyses proposed shall be used to collect and store samples. Above ground plant parts and debris will be excluded from the sample.

In addition to records outlined in Section 8.0, unusual surface conditions that may affect the chemical analyses will be recorded, such as (1) asphalt chunks that may have been shattered by mowers, thus spreading small fragments of asphalt over the sampling area, (2) distance to roadways, aircraft runways, or taxiways, (3) obvious, deposition of contaminated or clean soil at the site, (4) evidence of dumping or spillage of chemicals, (5) soil discoloration, and/or (6) unusual condition of growing plants, etc.

### **6.1.3 Surface Water Sampling**

Surface water sampling is not currently proposed, however, if field conditions warrant their collection the following procedures will be used.

Surface water samples will be collected in a manner that does not cause cross-contamination. If both water and sediment samples are being collected at a specific location, the water will be obtained first. Temperature, pH, specific conductance, and dissolved oxygen (when required) will be recorded at all surface water sampling points. The location where surface water or sediment samples are collected will be permanently marked (e.g., flagged stake in stream bank), and the location will be recorded on a site-specific project map.

The sample collection sequence is as follows: (1) if sampling water and sediment or just sediment, sampling will begin at the most downstream point and proceed upstream, (2) if sampling water only and the sample can be taken without disturbing the river or stream bottom, background samples will be collected first, then the farthest downstream sample, and then samples moving upstream toward the source or discharge point, (3) if sampling water only and the stream or river bottom must be disturbed, sampling will begin at the most downstream point and proceed upstream.

Samples shall be taken from the active portion of the stream on the side nearest the source of contamination or suspected plume. Water samples are collected using a Van Dorn sampler or Kemmerer sampler when grab samples are required, or using an autosampler (discrete or composite samples) with the inlet line located at the desired sampling depth. If approved by AFCEE, surface water samples may be collected by direct filling of

sample bottles. Samples from multiple locations are combined in a decontaminated bucket (nonvolatile samples only) and aliquots are taken for composite samples.

Surface water samples may also be obtained using a continuous automatic sampler. With a continuous sampler, an intake probe is secured at the sampling point and the sampler is pre-programmed to collect either individual or composite samples at designated times throughout the day.

The following records shall be maintained in addition to those in Section 8.0, (1) the width, depth, and flow rate of streams, (2) surface water conditions (e.g., floating oil or debris, gassing), (3) the location of any discharge pipes, sewers, or tributaries, and (4) instrument calibration.

#### **6.1.4 Sediment Sampling**

Sediment sampling is not currently proposed, however, if field conditions warrant their collection the following procedures will be used.

Sediment samples are collected from ponds, surface impoundments, and streambeds (both wet and dry). Sediment samples shall be collected using a PVC tube or dredge (Ponar, Peterson, or Ekman) when water is present. Each technique allows for the collection of discrete samples, with the option of compositing samples in either the field or the laboratory. Dry sediment samples may be collected by surface scraping, hand augering, or core sampling using a core sampler. Methods for dry sediment sampling are the same as that for soil. Sediment samples may be collected near discharge points in areas where sediment has accumulated inside an edge of a bend, an area where a stream suddenly widens, etc. The order of sample collection shall be the same as that described for surface water samples.

#### **6.1.5 Subsurface Soil Sampling**

Soil samples may be collected based on odors, discoloration and, organic vapor monitor readings. During drilling activities, soil samples will be collected using steel, continuous drive, California modified split-spoon samplers, or equivalent.

As soon as the split-spoon is opened, the soil will be monitored for organic vapors using a PID. Air monitoring results will be recorded on the boring log and in the field logbook. Section 7.1.1 details field screening procedures for soils.

Samples for VOC analysis will be collected as an entire 5 gram core using a U.S. Analytical core sampler. U.S. Analytical is a sampling device that collects and delivers soil samples into pre-tared 40-ml vials. Three cores will be collected from each VOC sampling location. VOC samples from large gravel or debris will be collected in a 4-ounce glass and extracted using Method SW846-5030. Following sample collection, each 40-ml vial will be capped to prevent volatilization. Each of the three 40-ml vials will be identified with a sample number on the existing label. An additional 4-ounce jar

will be collected to determine the percentage of moisture. Samples will be placed in a cooler and held at a temperature of 4°C.

Samples collected concurrently with VOC samples to be tested for other analytical parameters will be collected immediately adjacent to (above and below) the VOC sample interval. If VOCs are not collected, acetate liners may be used. Soil chemistry samples collected for analyses other than VOCs will be placed in 4-ounce, laboratory cleaned, USEPA-approved glass containers with Teflon lined lids. This will be done using clean stainless steel sampling tools. The sample will then be transferred into the appropriate sample container, sealed, labeled, and placed in an iced cooler held at a temperature below 4°C. If initial screening results indicate the presence of organic vapors, a headspace analysis will be conducted on remaining portions of the sample.

#### **6.1.5.1 Hollow Stem Auger Sampling**

For split-spoon samples collected using HSA, a standard penetration test will be performed in accordance with ASTM D-1586 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils." The sample is obtained by driving the sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. The sampler is first driven 6 inches to seat it in undisturbed soil; then the test is performed. The number of hammer blows for seating the spoon and making the test are then recorded for each 6 inches of penetration on the drill log (i.e., 5/7/8). The standard penetration test result (N) is obtained by adding the last two figures (i.e., 7+8=15 blows per foot). The sampler is then driven an additional 6 inches to fill the remainder of the split-spoon prior to retrieval.

### **6.2 SAMPLE HANDLING**

#### **6.2.1 Sample Containers**

Sample containers will be provided to field personnel, pre-cleaned and treated according to USEPA specifications for the methods. No sampling containers will be reused. Containers will be stored in clean areas to prevent exposure to fuels, solvents, and other contaminants.

##### **6.2.1.1 Sample Volumes, Container Types, and Preservation Requirements**

Sample volumes, container types, and preservation requirements for the analytical methods performed on AFCEE samples are listed in Table 3-3. The pH of preserved samples will be checked by the laboratory prior to analysis. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods used in this FSP are specified in Table 3-3.

### 6.2.2 Sample Identification

The following information will be written in the log book and on the sample label when samples are collected for laboratory analysis:

- Project identification (name and number)
- Sample identification number
- Sample location
- Preservatives added
- Date and time of collection
- Requested analytical methods
- Sampler's name

Each sample will be assigned a unique identification number that describes where and what type of sample was collected. The number that will be used in the field will consist of a maximum 15 digit alphanumeric code. Once data is ready to be entered into the ERPIMS database, the alphanumeric code will be truncated to 15 digits. This system is explained in detail as follows:

abbbbccdd-ee

where:

- a represents the medium (e.g., W = monitoring well, B = soil boring, or E = sediment sample)
- bbbb represents SAIC designation (e.g., SAIC)
- ccc represents the aquifer identification (e.g., Terrace Alluvium [TA] or Paluxy aquifer [PA])
- dd represents the location identification (LOCID) (e.g., 01, 02)
- ee represents the order that the sample was obtained within the soil boring; i.e., a surface soil sample would be 01, a 5- to 7-foot sample would be 02, etc. These two digits will be dropped once the data is entered into the ERPIMS database.

The first boring of this investigation will begin as number 001. For example, the soil sample collected from the first boring within the Terrace Alluvium would be identified as BSAICTA001-01. The second sample collected from soil boring 001 within the Terrace Alluvium would be identified as BSAICTA001-02. Duplicate samples will be submitted

to the laboratory blind. A note in the field log book and the Field Sampling Report form will identify the location and sample number that has been duplicated.

QC samples will be identified by the use of a similar system of identifiers with a maximum of 10 characters. The QC sampling number system is summarized below.

aabbccdd

where:

- aa represents medium (e.g. ER = equipment rinsate, TB = trip blank, AB = ambient blank, EB = equipment blank)
- bb represents the month, e.g. 06
- cc represents the day, e.g. 15
- dd represents the year, e.g. 00

For example, an equipment blank collected on the 15th day of June in the year 2000 will be "EB061500."

The project geologist will maintain a list that describes how each QC sample corresponds with specific environmental samples. For instance, each trip blank will be correlated with a particular set of samples shipped to the laboratory, and each rinsate will be correlated to those samples collected by a particular set of decontaminated sampling tools.

### 6.3 SAMPLE CUSTODY

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

COC records will be maintained for all field and field QC samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession, (2) it is in their view, after being in their possession, (3) it was in their possession, and they locked it up, or (4) it is in a designated secure area. All sample containers will be sealed in a manner that will prevent or detect tampering if it occurs. In no instance will tape be used to seal sample containers. Samples will not be packaged with activated carbon. Attachment B contains a sample COC form.

The following minimum information concerning the sample will be documented on the COC form:

- Unique sample identification
- Date and time of sample collection

- Source of sample (including name, location, and sample type)
- Designation of Matrix Spike/Matrix Spike Duplicate (MS/MSD)
- Preservative used
- Analyses required
- Name of collector(s)
- Serial numbers of custody seals and transportation cases (if used)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories
- Bill of lading or transporter tracking number (if applicable)

All samples will be uniquely identified, labeled, and documented in the field at the time of collection in accordance with Section 6.2.3 of the FSP. Samples collected in the field will be transported to the laboratory or field testing site as expeditiously as possible. When a 4°C requirement for preserving the sample is indicated, the samples will be packed in ice or chemical refrigerant to keep them cool during collection and transportation. During transit, it is not always possible to rigorously control the temperature of the samples. Generally, storage at low temperature is the best way to preserve most samples. A temperature blank (a VOC sampling vial filled with water) will be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory.

## **6.4 FIELD QUALITY CONTROL SAMPLES**

Field quality control samples such as blanks and duplicates will be collected as described in the following sections.

### **6.4.1 Ambient Blank**

The ambient blank consists of ASTM Type II reagent-grade water poured into a VOC sample vial at the sampling site. It is handled like an environmental sample and transported to the laboratory for analysis. Ambient blanks are prepared only when VOC samples are taken and analyzed only for VOC analytes.

Ambient blanks are used to assess the potential introduction of contaminants from ambient sources (e.g., active runways, engine test cells, gasoline motors in operation, etc.) to the samples during sample collection. Ambient blanks will be collected downwind of possible VOC sources. One ambient blank will be collected at the beginning of the field investigation. Additional ambient blanks will be collected if site conditions warrant.

#### **6.4.2 Equipment Blank**

An equipment blank is a sample of ASTM Type II reagent-grade water poured into, over, or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures. Equipment blanks will be collected immediately after the equipment has been decontaminated. The blank will be analyzed for all laboratory analyses requested for the environmental samples collected at the site. One equipment blank will be collected per day when environmental samples are collected.

#### **6.4.3 Trip Blank**

The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent-grade water, transported to the sampling site, handled like an environmental sample, and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and analyzed only for VOC analytes. Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. One trip blank will accompany each cooler of samples sent to the laboratory for analysis of VOCs.

#### **6.4.4 Field Duplicates**

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously, or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field so that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

Duplicate sample results are used to assess precision of the sample collection process. Precision of soil samples to be analyzed for VOCs is assessed from collocated samples because the compositing process required to obtain uniform samples could result in loss of the compounds of interest. One duplicate sample will be collected for every ten samples collected.

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## **7. FIELD MEASUREMENTS**

### **7.1 PARAMETERS**

#### **7.1.1 Field Screening of Soils and Rock Borings**

Data gap collection field activities will utilize field screening of soil for VOCs to provide data on the chemical characteristics of the soil at the investigation areas. During HSA drilling activities, soil samples will be monitored for organic vapors using an OVA. Headspace analysis will be performed on each lithologic and analytical soil sample collected. A portion of the recovered soil sample will be placed into a quart-size, re-sealable plastic bag, and the bag will be labeled, sealed, and shaken to mix the sample. The sample will be allowed to volatilize in a shaded area for approximately 15 minutes after which a headspace reading will be taken by punching through the bag with an OVA sampling tip. The OVA shall be calibrated using a standard of known concentration (e.g., isobutylene at 100 parts per million) in accordance with the requirements of the *Final Basewide QAPP* (HydroGeoLogic 1998). The sampling tip will not be placed in the soil, but in the headspace of the bag. A background headspace value will be obtained from an empty re-sealable plastic bag handled in a manner identical to the plastic bag containing the screening sample. The headspace reading and the background reading will be recorded on the Soil Boring Log (located in Attachment B in this FSP).

#### **7.1.2 Field Parameters for Water Samples**

The pH will be measured during groundwater purging using a portable pH meter. The meter will be recalibrated daily.

### **7.2 EQUIPMENT CALIBRATION AND QUALITY CONTROL**

Field equipment will be maintained and calibrated to the standards in their respective operations manuals. Equipment failures will be repaired in the field if possible, if not, the instrument will be tagged, removed from use, and returned for repair or replacement. Field equipment will be calibrated daily before the start of sampling activities. Calibration records will be maintained on the Field Log Book. The calibration record will include a unique instrument number (e.g., serial number), standards used, concentrations, and meter readings.

### **7.3 EQUIPMENT MAINTENANCE AND DECONTAMINATION**

#### **7.3.1 Equipment Maintenance**

Field equipment will be kept in a controlled storage room and will be decontaminated prior to return to storage; any malfunctions will be reported to the project geologist. The Field Coordinator will initiate actions necessary for the repair or replacement of defective equipment. Equipment maintenance logs are kept updated and on file. Power supplies of battery-powered instruments will be checked daily. Rechargeable instruments will be recharged daily.

### **7.3.2 Decontamination of Field Instruments**

Decontamination of field instruments will be instrument-specific. The probes of the pH meters will be rinsed with reagent-grade water before and after each use and at the end of each day. No decontamination is required for the OVA.

## **7.4 FIELD PERFORMANCE AND SYSTEM AUDITS**

The project geologist or a designated representative will conduct weekly informal audits of the field activities. The weekly audit for completeness will include the following items:

- Sample labels
- COC records
- Field notebooks
- Sampling operations
- Document control

The first three items above will be checked for completeness. Sampling operations will be reviewed to determine if they are performed as stated in the Work Plan or as directed by the project geologist. The informal document control audit will consist of checking each document for completeness, including items such as signatures, dates, and project numbers.

An unscheduled systems audit of field operations will be conducted using the project-specific Work Plan and will be used to review the total data generation. The audit will include on-site review of the field operational system, physical facilities for sampling, and equipment calibrations. A performance audit may be conducted by the PM and project geologist if deemed necessary by the PM, project geologist, lab coordinator, or client. The audit may focus on verifying that proper procedures are being followed so that subsequent sample data will be valid. Prior to the audit, a checklist will be prepared by the PM and Project Geologist that will serve as a guide for the performance audit.

The audit will verify whether or not the following items are being accomplished: (1) collection of samples follows the available written procedures, (2) COC procedures are followed for traceability of samples origin, (3) appropriate QC checks are being made in the field and documented in the field log book, (4) specified equipment is available, calibrated, and working properly, (5) sampling crews are adequately trained, (6) record-keeping procedures are being followed and appropriate documentation is maintained, and (7) corrective action procedures are followed. An audit report summarizing the results and corrections will be prepared and filed in the project files.

## **8. RECORD KEEPING**

SAIC will maintain field records sufficient to recreate all sampling and measurement activities and to meet all ERPIMS data loading requirements. The information shall be recorded with indelible ink in a permanently bound notebook with sequentially numbered pages. These records shall be archived in an easily accessible form and made available to the USAF upon request.

The following information will be recorded for all field activities: (1) location, (2) date and time, (3) identity of people performing activity, and (4) weather conditions. The following information will be recorded for all field measurements: (1) the numerical value and units of each measurement, and (2) the identity of and calibration results for each field instrument will also be recorded.

The following additional information will be recorded for all sampling activities: (1) sample type and sampling method, (2) the identity of each sample and depth(s), where applicable, from which it was collected, (3) the amount of each sample, (4) sample description (e.g., color, odor, clarity), (5) identification of sampling devices, and (6) identification of conditions that might affect the representativeness of a sample (e.g., refueling operations, damaged casing).

The following section describes the field documentation procedures, which will be followed as a means of recording observations and findings during the field investigation. Documentation will include the form of field logbooks, sample forms, site photographs, and drawings/sketches. All documentation will be completed in indelible ink and corrections will be stricken out with a single line and initialed. Examples of field forms are included in Attachment B in this FSP.

### **8.1 FIELD LOGBOOK**

Logbooks with sequentially numbered pages will be kept at the site during all field activities and will be assigned to each sample team. These logs will be updated, continually, and will constitute master field investigation documents. Information to be recorded in the logs includes, but is not limited to, the following:

- Project identification
- Field activity subject
- General work activity, work dates, and general time of occurrence
- Unusual events
- Subcontractor progress or problems

- Communication with the client or others
- Weather conditions
- SAIC personnel, subcontractors, and visitors on site
- Sample number and time of day for each sample collected for analysis
- Listing by sample number of samples collected during the day, sorted by COC record number (compiled at the end of the day)
- Record of telephone call to laboratory informing it of sample shipment
- Accomplishment of decontamination of drilling rig, construction materials, and sampling equipment
- Accomplishment of required calibration checks
- Disposition of purge water, decontamination fluids, and soil cuttings
- Variances from project plans and procedures (details will be recorded in the log book and presented in the report)
- Accomplishment of Tailgate Safety Meetings
- Review of project procedures with site personnel
- Head space screening and breathing zone readings
- Accomplishment of decontamination of water sampling equipment
- Photographs taken and identification numbers
- Name and signature of person making log book entries
- Inspections and results of inspections.

## **8.2 FIELD EQUIPMENT LOG BOOK**

Calibration of field testing equipment and documentation of the proper use and maintenance will be recorded in the field log book will be kept on site. Accompanying the field log book will be a operator manuals, specifications, and calibration requirements and procedures for all field testing equipment. Information to be recorded in the field log book includes the following:

- Equipment calibration status
- Equipment decontamination status
- Equipment nonconformance
- Equipment inspection and repair records
- Name and signature of person making entry
- Date of entry
- Name of equipment and its identifying number
- Nature of work conducted
- List or reference of procedures used for calibration or maintenance
- Manufacturer, lot number, and expiration date of calibration standards
- Measurement results

A sample collection log form (i.e., Field Sampling Report) will be completed for each sample collected during the investigation. An example of the Field Sampling Report Form is included in Attachment B in this FSP. Information to be included on the form includes the following:

- Date and time of sample collection
- Sample location
- Sample type (i.e., surface soil, sediment, groundwater, etc.)
- Name of person collecting samples
- Sample volumes and container types

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**APPENDIX FSP-A**  
**LABORATORY QUALITY ASSURANCE PROJECT PLAN**

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**QUALITY ASSURANCE PLAN**  
**FOR**  
**CHEMICAL ANALYSIS**

**Document ID: PDP - QAP - 02.1**



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**PDP Analytical Services**  
**1680 Lake Front Circle, Suite B**  
**The Woodlands, TX 77380**

# QUALITY ASSURANCE PLAN

FOR

## CHEMICAL ANALYSIS

Document ID: PDP - QAP - 02.1

RCN - uncontrolled

TO: \_\_\_\_\_

BY: \_\_\_\_\_

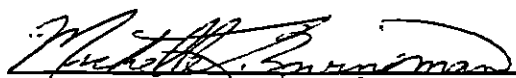
DATE: \_\_\_\_\_

RTN: \_\_\_\_\_


**QUALITY ASSURANCE PLAN**  
**FOR**  
**CHEMICAL ANALYSIS**

**Document ID: PDP - QAP - 02.1**

**Effective June 30, 1999**  
**Supersedes 2.0 (May 1, 1999)**

  
\_\_\_\_\_  
**Michelle L. Zwingman**  
**Quality Assurance Manager**

6/30/99  
**Date**

  
\_\_\_\_\_  
**Reddy Pakanati**  
**Vice President**

7/2/99  
**Date**

**Future Reviews and Date**

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**PDP Analytical Services**  
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**REVISION REQUEST FORM**

You are a copyholder of the Quality Assurance Plan (QAP) for PDP Analytical Services. This is a controlled document and has been assigned a unique record control number (RCN) as found below.

As a copyholder, you have the option to receive all revisions of this manual. Should you desire the most recent revision update, please complete the information requested below, tear off that section, and return it to the attention of the QA Manager at PDP Analytical Services, 1680 Lake Front Circle Drive, Suite B, The Woodlands, TX 77380.

Should you no longer desire custody of this manual, please notify the QA Manager at PDP Analytical Services, 1680 Lake Front Circle Drive, Suite B, The Woodlands, TX 77380. Arrangements for the return of this document and all revisions will be made.

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**Quality Assurance Plan for Chemical Analysis****DOC ID: PDP - QAP - 02.1****Copyholder:** \_\_\_\_\_**Company:** \_\_\_\_\_**RCN:** \_\_\_\_\_**By:** \_\_\_\_\_*M. L. Zwingman, QA Mgr.*  
*01/18/00***Date Issued:** \_\_\_\_\_**Date Rtn.:** \_\_\_\_\_**Copyholder Address:** \_\_\_\_\_**Copyholder Phone Number:** \_\_\_\_\_

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## INTRODUCTION

### Section 1

#### 1.1. Description of Document

The PDP Analytical Services (PDP) Quality Assurance Plan (QAP) presents an overview of the essential elements of PDP's Quality Assurance program. PDP has modeled this plan along USEPA guidelines as outlined in the individual methodologies,<sup>1</sup> the official document for creating QAPs,<sup>2</sup> and the Good Laboratory Practices outline.<sup>3</sup> The QAP also incorporates the elements outlined in the USEPA Contract Laboratory Program Statements of Work (CLP SOW),<sup>4</sup> the Air Force Center for Environmental Excellence Quality Assurance Project Plan (AFCEE QAPP),<sup>5</sup> the Navy Installation Restoration Laboratory Quality Assurance Guide,<sup>6</sup> the Army Corps of Engineers laboratory quality plan<sup>7</sup> and Texas Natural Resource Conservation Commission State Superfund Engineering Section Pollution Clean-up Division Quality Assurance Project Plan.<sup>8</sup>

##### 1.1.1. Expectation of Document

The QAP is designed and implemented to describe the procedures used to monitor and control the quality of data generated in this laboratory.

- 1.1.1.1. Adherence to the QAP maintains data integrity, validity, usability, and reliability.
- 1.1.1.2. Adherence to the QAP ensures that analytical measurement systems are maintained in an acceptable state of stability and reproducibility.
- 1.1.1.3. Adherence to the QAP detects problems through data assessments and establishes reliable corrective action procedures to correct them.
- 1.1.1.4. Adherence to the QAP documents all aspects of the measurement process which provides data that are technically sound and legally defensible.

### 1.1.2. Purpose of Document

The Quality Assurance and Quality Control (QA/QC) policies and procedures described herein are designed to eliminate systematic errors and minimize the occurrence of other errors. The QA/QC program forms the framework for minimizing errors by identifying and correcting those errors which do occasionally occur. These QA/QC policies and procedures must be coupled with the professional judgment of the technical staff in interpreting the events surrounding the generation of the final result to ensure that quality data is consistently produced.

### 1.1.3. Validity of Document

It is the responsibility of all personnel involved in the generation and reporting of data at PDP to read, understand, and follow the provisions outlined in this document. The QAP is meant to be a training tool and source of information; valid and current information is a must. It is the responsibility of each employee to report changes in procedure, as a result of policy or regulatory changes, to the QA Manager who initiates the updating process. The QA Manager must also be informed of any errors or omissions that may be found in this document.

To ensure the continued validity of the policies contained in the QAP, this document is subject to the same review process and frequency as all controlled documents. *(See Section 14.3 for details regarding the controlled document review process.)*

## 1.2. Quality Assurance Policy

PDP is committed to providing quality environmental analytical services to both the public and private sectors. To ensure the production of scientifically sound and legally defensible data of known and documentable quality, an extensive QA/QC program to be strictly followed by all PDP personnel has been adopted. The effectiveness of this program relies on well defined objectives, well documented procedures, a thorough audit system, and management support. PDP is committed to the philosophy that optimum quality can be better achieved through proactive and preventative quality assurance management rather than reactive and curative measures. All personnel within PDP play a vital role in assuring the quality of their work. PDP holds that a successful, strong, and

viable QA/QC program is dependent upon the continued commitment of all employees. In order to effectively monitor the QA/QC program, a QA Manager is dedicated to execute the policies found in the PDP QAP.

### **1.3. Governing Documents**

The complete documentation of the QA/QC program at PDP requires different types of operational and QA documents. Examples of those completed on a daily or repetitive basis are presented in attachment sections at the end of this document. However, there are other governing documents used at PDP. These are presented below in descending order of hierarchy.

#### **1.3.1. Safety Policies**

The protection of PDP employees from exposure to potentially hazardous substances and/or injurious events takes precedence over all other company policies. Employee activities, at the request of laboratory management and/or clientele, shall in no way challenge or conflict with the provisions set forth in the PDP Chemical Hygiene Plan, the Emergency Action Plan (EAP), the Chemical Spill Policy, or the regulations set forth by OSHA.

#### **1.3.2. Client Contracts and Quality Assurance Project Plans**

- 1.3.2.1. Subject only to the provisions of PDP's Safety Policies outlined in 1.3.1, the contract with the client has the highest authority and control.
- 1.3.2.2. A Quality Assurance Project Plan (QAPP) is a written document which presents the policies, organization, objectives, functional activities, and specific QA/QC activities for project management, field, and laboratory operations. It is designed to achieve the project data quality goals. It is important that the PDP's QAP is consistent with the client's QAPP and that any discrepancies be discussed and resolved before analytical activity commences. The QAPP holds similar authority and control as the Client Contract.

---

### 1.3.3. PDP Quality Assurance Plan (PDP QAP)

The QAP is the general authority for laboratory QA. It is subject to the provisions of the Safety Policies and Client Contracts outlined in 1.3.1 and 1.3.2.

### 1.3.4. PDP Standard Operating Procedures (SOPs)

SOPs are the final level of governing authority and subject to all provisions of the Safety Policies, Client Contracts, and the QAP outlined in sections 1.3.1 to 1.3.3. The SOP gives specific QA/QC, safety, method, and equipment requirements for the analysis being performed.

## 1.4. Endnotes (Works Cited)

<sup>1</sup> *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (USEPA SW-846, 3<sup>rd</sup> ed., through 1996 [latest] update).

<sup>2</sup> *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (USEPA, 1983).

<sup>3</sup> *Good Laboratory Practice Standards* (USEPA, September 1993).

<sup>4</sup> *USEPA Contract Laboratory Program, Revised, ILMO4.0, OLCO2.1, and OLMO3.2.*

<sup>5</sup> *HQ Air Force Center for Environmental Excellence Quality Assurance Plan, ver. 3.0* (US AFCEE, March 1998).

<sup>6</sup> *Interim Navy Installation Restoration Laboratory Quality Assurance Guide* (US NFESC, February 1996).

<sup>7</sup> *Army Corps of Engineers Laboratory Quality Plan, Interim document.*

<sup>8</sup> *TNRCC State Superfund Engineering Section Pollution Clean-up Division Quality Assurance Project Plan, Doc. ID: 970715.1* (TNRCC, July 1997).

## RESPONSIBILITIES, AUTHORITIES AND PERSONNEL

### Section 2

#### 2.1. General Personnel Guidelines

PDP Analytical Services (PDP) is organized along clear lines of authority to provide clients with service that is efficient and reliable. (*See Attachment I: U for the organizational chart.*) It is important that employees understand the operational structure as outlined through technical divisions and accepted by quality assurance. Each employee should also understand that even though QA operates independently from operations, quality must be integrated into all aspects of PDP operations.

##### 2.1.1. Organization/Functional Groups

- 2.1.1.1. Sample Management/Control
- 2.1.1.2. Organic Laboratory
  - a. Extraction
  - b. GC
  - c. GC/MS
- 2.1.1.3. Inorganic Laboratory
  - a. Sample Preparation
  - b. Metal Laboratory
  - c. General [Wet] Chemistry
- 2.1.1.4. Computer Support Systems
- 2.1.1.5. Project Management
  - a. Data Entry
  - b. Report Generation
- 2.1.1.6. Contracts Administration/Business Development
- 2.1.1.7. Quality Assurance/Control
- 2.1.1.8. Health and Safety

---

## **2.1.2. Authority and Responsibility**

### **2.1.2.1 Authority**

The section leader of each department has full supervisory control over his or her staff allowing for an organized chain of authority. However, all laboratory personnel have the authority, granted through the Laboratory Manager, to accept or reject data based on compliance with well defined QC criteria. The final acceptance or rejection of data must be approved by the section leader and QA Manager.

### **2.1.2.2. Responsible Duties**

All laboratory personnel are responsible for having a thorough knowledge of the QAP and all SOPs specific to the analyses or tasks performed and/or supervised, ensuring that all required instrument tuning and calibration is followed prior to conducting any analysis, ensuring that all QC criteria is met and documentation related to the analysis is completely and accurately performed, and immediately reporting to management if any problem arises during execution including, but not limited to, calibration, QC, or unexpected delays.

## **2.2. Key Position Descriptions**

Specific information regarding personnel currently holding the key positions may be found in the PDP Statement of Qualifications (SOQ).

### **2.2.1. Laboratory Manager**

The Laboratory Manager at PDP is responsible for ensuring adequate training and supervision of all activities involved in generating analytical data. This oversight of operations includes working closely with section leaders and providing necessary technical support to all members of the PDP staff. The Laboratory Manager participates in all meetings and discussions pertaining to technical matters. The Laboratory Manager reports directly to the President of PDP.



## **2.2.2. Quality Assurance Manager**

The QA Manager is responsible for all QA/QC efforts at PDP. The QA Manager reports directly to the President of PDP and has the responsibility for overseeing and regulating all laboratory functions. The QA Manager operates independently of all areas generating analytical data to ensure complete objectivity in the evaluation of laboratory operations.

### **2.2.2.1. Basic Responsibilities**

- a. Implement QA/QC policies
- b. Monitor the implementation of the QAP within the laboratory to ensure complete compliance with QA objectives
- c. Conduct in-house audits to identify existing and potential problems and compliance with written SOPs
- d. Writing, updating, and distributing SOPs
- e. Reporting the status of the laboratory QA/QC program to management with formal and informal communications
- f. Monitor laboratory performance towards holding times, turn around times, and instrument performance
- g. Review final reports
- h. Prescribe and monitor corrective actions

### **2.2.2.2. Authority**

- a. Final authority regarding data quality
- b. May require procedures to be amended or discontinued
- c. May require analyses to be suspended or repeated
- d. May suspend or terminate employees on the grounds of dishonesty, incompetence, or repeated non-compliance with QA/QC procedures. This authority comes from the President of PDP.

## **2.2.3. Project Manager**

The Project Manager is responsible for assisting clients with any needs concerning their projects. Before samples arrive, the Project Manager reviews the Quality Assurance Project Plan (QAPP) and client contract to ensure familiarity with the specific requirements of the project. The information is conveyed to the management and section leaders. The

Project Manager is the focal point in the project to ensure technical efforts and communication are efficiently and effectively coordinated. The Project Manager report directly to the Laboratory Manager.

**2.2.3.1. Basic Responsibilities**

- a. Prepare bottle orders
- b. Oversee and approve log-in of samples
- c. Coordinate resolution efforts of data
- d. Final review of data package to ensure completeness and compliance with Client Contract

**2.2.4. Accounts Manager**

The Accounts Manager is responsible for the financial development of the company. The Accounts Manager solicits business through presentations, referrals, and continued relations with clients. The Accounts Manager drafts bid proposals based on the client specifications and current laboratory abilities. As the main client services representative, the Accounts Manager is also responsible for any business resolutions which need to be addressed due to unexpected delays, errors, or concerns. The Accounts Manager reports directly to the President of PDP.

**2.2.5. Section Managers and Supervisors**

Section managers and supervisors (section leaders) are responsible for the daily operation of their department. This position reports directly to the Laboratory Manager.

**2.2.5.1. Basic Responsibilities**

- a. Performance of analyses, extractions, and/or preparations
- b. Review and approve data
- c. Instrument maintenance and troubleshooting
- d. Personnel scheduling to meet workload requirements
- e. Inventory maintenance
- f. Training and safety monitoring
- g. Review SOPs at the request of the QA Manager
- h. Set-up of automatic equipment

## **2.2.6. Analysts**

Analysts are directly involved in the primary day-to-day business of PDP by performing identification tests on environmental samples. Analysts report directly to their section leader.

### **2.2.6.1. Basic Responsibilities**

- a. Analyze, extract, or prepare samples by approved methodologies
- b. The systematic documentation of identification tests
- c. Instrument maintenance and troubleshooting
- d. Standards, reagents, and glassware preparations
- e. Data reduction and review
- f. Assist in the review of SOPs at the request of the QA Manager or section leader
- g. Assist in the cross-training of other analysts

## **2.2.7. Technicians**

Technicians are primarily responsible for the extraction of samples, glassware preparations, and clean-up procedures. Technicians may perform some analytical preparatory tasks after proper training in the methodology and documentation requirements. Technicians report directly to their section leader.

## **2.2.8. Systems Manager**

The Systems Manager is responsible for the management of all computer systems in the laboratory. This includes generating and updating all electronic data deliverables (EDDs), electronic data back-ups, electronic archival, software review and validity verifications, and hardware/software maintenance. The Systems Manager reports directly to the Laboratory Manager.

## **2.2.9. QC Coordinator and Report Generation Clerks**

The QC Coordinator and Report Generation Clerks are responsible for all aspects of the compilation of the final report. Their duties may include data entry, data review, report organization, copying, or packaging. The

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QC Coordinator and Report Generation Clerks report to the Laboratory Manager. At their discretion, however, they may direct technical concerns to the QA Manager for consideration.

#### **2.2.10. Health and Safety Officer**

The Health and Safety Officer at PDP is a designated individual who ensures that all employees are fully prepared for the possible occurrences inherent to their positions. The Health and Safety Officer initially trains all new employees. In addition, the Health and Safety Officer oversees continuing programs and general adherence to laboratory safety which is directly enforced by section leaders. The Health and Safety Officer interacts with all levels of the PDP organization, but reports to the Laboratory Manager who reinforces necessary policy changes.

### **2.3. Areas of Training**

PDP maintains a firm commitment to its clients to deliver quality data through the employment and continued training of highly qualified personnel. New employees at PDP receive training in three distinct areas to initiate orientation to the new surroundings and modes of operation. While the training program is informal, it is comprehensive. The program is structured towards both short-term and long-term goals, and all training is documented. The line of training for each employee is unique and dependent upon scientific background and work experience. PDP strives to maintain the most productive and technically functional employees in its work force. Efficient and effective training facilitates a smooth transition of new employees in terms of competence and functionality within the defined responsibilities of the position. *(See the pertinent QA SOP for more guidance regarding training procedures.)*

#### **2.3.1. Human Resources**

The Laboratory Manager covers information pertaining to benefits, salary, vacation, and sick time with the new employee. Those matters pertaining to the holiday schedule, pay days, anti-drug policy, and tax forms are covered by the Business Secretary.

### 2.3.2. Health and Safety

Each new employee receives safety training as part of the PDP Health and Safety program overseen by the Health and Safety Officer. The initial session is conducted by the Health and Safety Officer or designee and presented through the use of video tapes, handbooks, and internal health and safety documents such as the PDP Chemical Hygiene Plan, the Emergency Action Plan, the Chemical Spill Policy, and the regulations set forth by OSHA. Each employee has access to all written materials which should be consulted as reference documents. Through periodic and repetitive training seminars, overseen by the Health and Safety Officer, the health and safety training at PDP is continuous and maintains itself as a natural function within the daily routine of the employees. All training activities are documented on a PDP Training Attendance Sheet (*See Attachment II: A & B*) and placed in the QA file of the employee.

### 2.3.3. Technical

Technical training at PDP is department-dependent and carried out by seasoned analysts, section leaders, and/or the Laboratory Manager. PDP utilizes on-the-job training, computer enhancement, specialized training by instrument manufacturers, conferences, seminars, instrument training manuals, published and internal methodologies, and single blind performance evaluation (PE) sample analysis.

## FACILITY AND EQUIPMENT

### Section 3

#### 3.1. Facility

##### 3.1.1. Location

PDP Analytical Services (PDP) is located in The Woodlands, a suburb of Houston, Texas. It is in the immediate vicinity of Interstate 45 (the North Freeway) and Research Forest Drive at 1680 Lake Front Circle Drive, Suite B, The Woodlands, TX, 77380.

##### 3.1.2. Building

The facility occupies approximately 13000 square feet of floor space with fifteen (15) distinct work areas. An additional 7000 square feet is available for expansion. Laboratory work areas contain approximately 400 linear feet of bench space and fifty (50) linear feet of hood space. (See Attachment I: A for floorplan)

#### 3.2. Equipment

PDP has service contracts with manufacturers for all major instrumentation. Highly specialized and experienced service personnel provide routine, preventative maintenance training to employees, major repairs, and quick replacements of parts. The use of manufacturer service personnel minimizes instrument down-time and loss of productivity. (See Section 11 for more specific information regarding instrument maintenance.) PDP maintains an ample supply of spare parts for internal maintenance and repairs. (See Attachment I: B, C, & D for comprehensive equipment lists.)

#### 3.3. Standards, Reagents, Solvents, Gases, and Supplies

##### 3.3.1. Requirements

All chemicals, gases, and supplies are purchased through the designated purchasing agent from reputable manufacturing and supply companies.

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Materials of analytical grade are required for chemical reagents and solvents. Ultra high purity is required for gases and standards. All chemicals, prior to ordering, must be approved for use in the specified analysis.

### 3.3.2. Tracking

Upon receipt, the purchasing agent verifies the shipment and records this information in a receiving logbook. Once confirmed, the supplies are distributed to the necessary departments where the section leader or designee further verifies the order by checking the quality of the received materials. Each reagent, solvent, and standard container label is signed and dated by this individual to show receipt. The individual opening the container must do the same, as well as, enter the expiration date. (*See the pertinent Administration SOP for specific information regarding technical supplies.*)

Chemical reagents, solvents, and standards are tracked via the manufacturer lot number. As the chemicals are used, the lot number is recorded in the appropriate logbook. For standards, a certificate of analysis which describes the National Institute of Standards and Technology (NIST) traceability and certified quality is supplied by the vendor and kept on file by the user.

Periodic inventories of chemicals and supplies are carried out by section leaders.

### 3.3.3. Storage and Safety

All supplies are stored in designated areas based on manufacture recommendations and safety requirements. Gas cylinders are stored in the appropriate laboratory area and strapped to prevent falling. Filters or traps within the gas lines to the cylinders are provided on some instrumentation as an added precaution to filter out unwanted materials.

## SAMPLE CUSTODY

### Section 4

#### 4.1. Chain-of-Custody

Chain-of-Custody procedures document the history of samples and constitute a crucial part of the sampling and analysis programs. Chain-of-Custody documentation enables the identification and tracing of a sample from the time of collection through disposal or return to the client.

##### 4.1.1. Documentation of Form

Blank PDP Analytical Services (PDP) Chain-of-Custody forms are supplied by the laboratory to the client if requested. (*See Attachment II: C for PDP Chain-of-Custody.*) As samples are collected in the field, entries are made on the Chain-of-Custody form by the samplers. PDP recommends the complete Chain-of-Custody include the information listed in 4.1.1.1. through 4.1.1.8.

- 4.1.1.1. Sample ID
- 4.1.1.2. Date and time of sampling per sample ID
- 4.1.1.3. Sample description
- 4.1.1.4. Container and preservative
- 4.1.1.5. Required analyses
- 4.1.1.6. Client and/or sample program
- 4.1.1.7. Special instructions or notes
- 4.1.1.8. Signature of sampler

##### 4.1.2. Documentation of Sample Containers

As samples are collected, identification information should be recorded on each individual sample container. PDP recommends that a complete sample container label include the information found in 4.1.2.1 through 4.1.2.6.

- 4.1.2.1. Sample ID
- 4.1.2.2. Date and time of sampling



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- 4.1.2.3. Sample description
  - 4.1.2.4. Preservative (or "none" if the container holds a neat [unpreserved] sample)
  - 4.1.2.5. Analysis to be done from specific container
  - 4.1.2.6. Client and/or sample program

## 4.2. Sample Receipt

When samples are received at the laboratory, a designated sample custodian signs for receipt of the samples, verifies each sample against the Chain-of-Custody form, and notes any discrepancies or damage. All Chain-of-Custody documents are signed and dated; air bill numbers, if applicable, are recorded on the Sample Receipt and Login Checklist (SRLC). (*See Attachment II: D for the SRLC.*)

### 4.2.1. Chain-of-Custody and Sample Verification

Samples are inspected for integrity by review of the enclosed documentation (*i.e.* Chain-of-Custody, labels, sample tags, *etc.*) for accuracy, completeness, and agreement. The appropriateness of sample containers, preservatives used for requested analyses, sufficiency of sample volume, and holding times are verified. (*See Attachment I: E (aqueous) and F (solid) for bottle, preservative, and holding time information.*) A copy of the Chain-of-Custody, the SRLC, and any deficiency notes are faxed to the client for review. The originals are maintained in the episode file.

- 4.2.1.1. Should any appropriate documentation not be included, the sample custodian notes this on the SRLC and notifies the Project Manager. The client is notified and any missing information is requested.
- 4.2.1.2. If incorrect preservation, improper container use, insufficient sample volume, or sample damage is found, the sample custodian notes this on the SRLC and notifies the Project Manager. The Project manager contacts the client to discuss the situation and determine the management of the samples and affected analyses.

#### 4.2.2. Laboratory Identification

Each sample that is received by the laboratory is assigned a unique and sequential number which identifies the sample in the internal tracking system and software recording. References to a sample in any communication after this assignment will include the assigned sample number for positive identification. The client identification is used as a secondary check of sample identification.

#### 4.3. Internal Sample Custody

Samples remain under the control of the designated sample custodian until transferred to the analyst or technician for sample analysis. All analysts and technicians are required to check samples in and out on the internal custody log. (*See Attachment II: E for internal Chain-of-Custody form.*) Extracts and digestive preparations are relinquished by the preparer to the analyst and recorded in the extraction or preparation logbook.

##### 4.3.1. Refrigerator Storage

All samples are stored in walk-in refrigerators at 4°C. Sample extracts are stored separately in a designated refrigerator at 4°C. The temperature of all refrigerators are monitored and recorded daily by the sample custodian. (*See Attachment I: G for a listing of refrigerators and the stored contents.*)

#### 4.4. Sample Retention, Archival, and Disposal

After all analyses and data reporting are complete, the samples are retained in the custody of the sample custodian in refrigerated storage for a minimum of thirty days. After thirty days, the project manager determines whether the samples are to be disposed, returned, or held longer as detailed in 4.4.1 through 4.4.3.

##### 4.4.1. Disposal

All extracts, samples, and preparations regarding a project will be disposed of by an approved disposal company. Client and laboratory identifications, sample matrices, and disposal dates are recorded in the disposal logbook for tracking and custody purposes. (*See Attachment II: F for disposal logbook form.*)

**4.4.2. Return to Client**

Upon written request, client samples for a project will be returned. A Chain-of-Custody form must accompany the returned samples for tracking and custody purposes.

**4.4.3. Client Requested Exceptions**

If a client requires, the samples and extracts may be held for a longer duration. Currently, CLP extracts are maintained for 365 days. Other requested exceptions can be made as long as appropriate regulatory guidelines are maintained.

## **CALIBRATION: PROCEDURES, FREQUENCY, DOCUMENTATION, AND QUALITY CONTROL**

### **Section 5**

All procedures and other information in this section are generalized. The current Standard Operating Procedure for the pertinent analysis takes precedence. Any question regarding discrepancies should be brought to the attention of the Quality Assurance Manager.

#### **5.1. Reference/Traceable Materials**

Whenever possible, primary reference materials are obtained from the National Institute of Standards and Technology (NIST), the Environmental Protection Agency (EPA), or, in the absence of availability, other reliable sources. These reference materials are used for instrument calibration, quality control spikes, and/or performance evaluations. Secondary reference materials may be used for these functions provided they are traceable to a NIST standard or compared to a NIST standard within the laboratory.

#### **5.2. Standard and Reagent Preparation**

The generation of quality data is directly linked to the purity/quality of the standard solution, reagents, and solvents used in the analytical process. PDP Analytical Services (PDP) documents and monitors the quality of reagents and standards.

Traceability is paramount for successful documentation. If available, certified standards with the applicable documentation are obtained from external sources such as the National Institute of Standards and Technology (NIST) or the EPA Repository. The standards are recorded in a logbook with unique identification numbers to aid in tracing the source. All solvents and reagents are dated as they are received. *(See Section 3.3 for more information regarding the handling of standards, reagents, and solvents.)*

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### 5.3 Instrument Calibration

Before any instrument is used as a measurement device, the instrument response to known reference materials is determined. The manner in which the various instruments are calibrated depends upon the particular instrument and its intended use. Preparation of all materials used for calibration are documented in a standards preparation notebook.

#### 5.3.1. Balances

Laboratory balances are checked before use on a daily basis by a designated technician and calibrated annually by a certified third-party company. A record of daily calibrations are kept in the balance logbook.

#### 5.3.2. Oven Thermometers

Oven thermometers are calibrated annually against a NIST certified thermometer in the range of interest. Annual calibrations are recorded in a calibration notebook. Daily readings are recorded with the respective analysis.

#### 5.3.3. Gas Chromatography/Mass Spectroscopy (GC/MS)

##### 5.3.3.1. Instrument Performance Documentation

- a. Mass spectrometers are tuned every twelve (12) hours of analysis or the method-specified time elapse with Decafluorotriphenylphosphine (DFTPP), for semi-volatile analysis, and 4-Bromofluorobenzene (BFB), for volatile analysis.
- b. Ion abundances must fall within the windows dictated by the specific program requirements.
- c. Once an instrument has been tuned, initial calibration curves for representative analytes containing known amounts of authentic standards are generated at three to six concentration levels. The calibration curve brackets the anticipated working range of the analytes.
- d. Calibration data, including linearity verification determined by the response factor evaluation, are maintained in the laboratory permanent records.

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**5.3.3.2. Method Performance Documentation**

- a. Each day, every twelve (12) hours of analysis, or as specified in the method, whichever elapsed time is the least, a midpoint calibration standard is analyzed to verify that instrument responses are still within the initial calibration determinations.
- b. The percent difference (%D) is calculated and recorded. If the %D exceeds the method criteria, appropriate corrective actions are taken.
- c. All GC/MS sample analyses include the analysis of a method blank and laboratory control sample (LCS). A Laboratory control sample duplicate (LCSD), matrix spike (MS), and matrix spike duplicate (MSD) are optional and performed only if sufficient sample is present.
- d. Appropriate surrogate compounds specified in EPA methods are spiked into each sample and all QC samples.
- e. Recoveries from method spikes and surrogate compounds are calculated and recorded.

**5.3.4. Gas Chromatography (GC)**

The calibration procedures for GC are very similar to those for GC/MS.

**5.3.4.1. Instrument Performance Documentation**

- a. Calibration curves for representative analytes are generated at three to five levels of concentration. The calibration curve brackets the anticipated working range of the analysis.
- b. For pesticide analyses, a performance evaluation standard is analyzed daily to monitor the levels of Endrin and DDT breakdown.
- c. Calibration data, including linearity verification determined by the response factor evaluation, are maintained in the laboratory permanent records.

**5.3.4.2. Method Performance Documentation**

- a. Each day, every twelve (12) hours of analysis, or as specified in the method, whichever elapsed time is least, a midpoint calibration standard is analyzed to verify that

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- instrument responses are still within the initial calibration determinations.
- b. The percent difference (%D) is calculated and recorded. If the %D exceeds the method criteria, full recalibration is done.
  - c. Second column confirmation is to be performed, where applicable to the method.
  - d. All GC sample analyses include the analysis of a method blank, a matrix spike (MS), matrix spike duplicate (MSD), a laboratory control sample (LCS), and a laboratory control sample duplicate (LCSD).
  - e. Appropriate surrogate compounds, as specified in approved methodologies are spiked into each sample and all QC samples.
  - f. Recoveries from method spikes and surrogate compounds are calculated and recorded.

### 5.3.5. High Performance Liquid Chromatography (HPLC)

The calibration procedures for HPLC are very similar to those for GC.

#### 5.3.5.1. Instrument Performance Documentation

- a. Calibration curves for representative analytes are generated at three to five levels of concentration. The calibration curve brackets the anticipated working range of the analysis.
- b. Calibration data, including linearity verification determined by the response factor evaluation, are maintained in the laboratory permanent records.

#### 5.3.5.2. Method Performance Documentation

- a. Each day, every twelve (12) hours of analysis, or as specified in the method, whichever elapsed time is least, a midpoint calibration standard is analyzed to verify that instrument responses are still within the initial calibration determinations.
- b. The percent difference (%D) is calculated and recorded. If the %D exceeds the method criteria, full recalibration is done.

- c. All HPLC sample analyses include the analysis of a method blank, a matrix spike (MS), matrix spike duplicate (MSD), a laboratory control sample (LCS), and a laboratory control sample duplicate (LCSD).
- d. Appropriate surrogate compounds, as specified in approved methodologies, are spiked into each sample and all QC samples.
- e. Recoveries from method spikes and surrogate compounds are calculated and recorded.

### 5.3.6. Ion Chromatography (IC)

The calibration procedures for IC are very similar to those for GC and HPLC.

#### 5.3.6.1. Instrument Performance Documentation

- a. Calibration curves for representative analytes are generated at three to five levels of concentration. The calibration curve brackets the anticipated working range of the analysis.
- b. Calibration data, including linearity verification determined by the response factor evaluation, are maintained in the laboratory permanent records.

#### 5.3.6.2. Method Performance Documentation

- a. Each day, every twelve (12) hours of analysis, or as specified in the method, whichever elapsed time is least, a midpoint calibration standard is analyzed to verify that instrument responses are still within the initial calibration determinations.
- b. The percent difference (%D) is calculated and recorded. If the %D exceeds the method criteria, full recalibration is done.
- c. All IC sample analyses include the analysis of a method blank, a matrix spike (MS), matrix spike duplicate (MSD), a laboratory control sample (LCS), and a laboratory control sample duplicate (LCSD).
- d. Appropriate surrogate compounds specified in EPA methods are spiked into each sample and all QC samples.



- e. Recoveries from method spikes and surrogate compounds are calculated and recorded.

### 5.3.7. Atomic Absorption Spectrophotometry (AA)

#### 5.3.7.1. AA Calibration

- a. The AA is calibrated prior to use each day.
- b. The working calibration standards are to be prepared daily from traceable materials.
- c. The working calibration standards include a blank and a minimum of three (3) concentrations to cover the anticipated range of measurement.
- d. At least one of the working calibration standards must be at or slightly below the desired detection limit.
- e. The correlation coefficient for the calibration plot must meet at least 0.995 in order to consider the instrument responses linear over the range. If the 0.995 correlation coefficient is not achieved, the instrument is to be recalibrated.
- f. Calibration data, including the correlation coefficient, are maintained in the laboratory permanent records.

#### 5.3.7.2. AA Quality Control

- a. All AA sample analyses include the analysis of a method blank (one per batch or five percent (5%) of the samples, whichever is greater), a matrix spike (MS), matrix spike duplicate (MSD), a laboratory control sample (LCS), and a laboratory control sample duplicate (LCSD).
- b. The method blank(s) are analyzed to ensure the absence of laboratory introduced contamination.
- c. The LCS and LCSD are to be at a concentration of at least five (5) times the reporting limit.
- d. The LCS, LCSD, MS, and MSD are analyzed to ensure the accuracy of the analysis by demonstrating a percent recovery within the applicable range for the tested analyte.
- e. Precision is measured by the reproducibility between the LCS and LCSD and the MS and MSD.

### 5.3.8. Inductively Coupled Plasma Spectroscopy (ICP)

#### 5.3.8.1. ICP Calibration

- a. The ICP is calibrated prior to use each day.
- b. The working calibration standards are to be prepared daily from traceable materials.
- c. The working calibration standards include a blank and a standard.
- d. The calibration is verified with a mid-range calibration check standard prepared from a different reference material than the instrument calibration standard.

#### 5.3.8.2. ICP Quality Control

- a. All ICP sample analyses include the analysis of a method blank, a matrix spike (MS), matrix spike duplicate (MSD), a laboratory control sample (LCS), and a laboratory control sample duplicate (LCSD).
- b. The method blank is analyzed to ensure the absence of laboratory introduced contamination.
- c. The LCS and LCSD are to be at a concentration of at least five (5) times the reporting limit.
- d. The LCS, LCSD, MS, and MSD are analyzed to ensure the accuracy of the analysis by demonstrating a percent recovery within the applicable range for the tested analyte.
- e. Precision is measured by the reproducibility between the LCS and LCSD and the MS and MSD.

### 5.3.9. Total Organic Carbon (TOC)

#### 5.3.9.1. TOC Calibration

- a. The TOC analyzer is calibrated prior to use each day.
- b. Working calibration standards from a potassium hydrogen phthalate reference material solution are prepared fresh daily.
- c. The working standards include a blank and at least one spike concentration.

#### 5.3.9.2. TOC Quality Control

- a. All TOC sample analyses include the analysis of a method blank, a laboratory control sample (LCS), and a laboratory control sample duplicate (LCSD).

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- b. The method blank is analyzed to ensure the absence of laboratory introduced contamination.
  - c. The LCS and LCSD are to be at a concentration of at least five (5) times the reporting limit.
  - d. The LCS and LCSD are analyzed to ensure the accuracy of the analysis by demonstrating a percent recovery within the applicable range for the tested analyte.
  - e. Precision is measured by the reproducibility between the LCS and LCSD.

### 5.3.10. UV Spectrophotometric Methods

#### 5.3.10.1. Spectrophotometer Calibration

- a. The spectrophotometer is calibrated prior to use each day.
- b. Working calibration standards are prepared fresh daily from traceable materials appropriate to the specific analysis.
- c. The working standards include a blank and at least five spike concentrations which cover the anticipated instrument range. At least one calibration standard is at or slightly below the desired detection limit.
- d. The correlation coefficient for the calibration plot must meet at least 0.995 in order to consider the instrument responses linear over a given range. If the 0.995 correlation coefficient is not achieved, the instrument is to be recalibrated.
- e. Calibration data, including the correlation coefficient, are maintained in the laboratory permanent records.

#### 5.3.10.2. Spectrophotometer Quality Control

- a. All spectrophotometer sample analyses include the analysis of a method blank, a laboratory control sample (LCS), and a laboratory control sample duplicate (LCSD).
- b. The method blank is analyzed to ensure the absence of laboratory introduced contamination.
- c. The LCS and LCSD are to be at a concentration of at least five (5) times the reporting limit.
- d. The LCS and LCSD are analyzed to ensure the accuracy of the analysis by demonstrating a percent recovery within the applicable range for the tested analyte.

- e. Precision is measured by the reproducibility between the LCS and LCSD.

#### 5.4. Calibration Calculations

##### 5.4.1. Calculation of Standard Deviation

The standard deviation,  $s$ , of  $n$  measurements of  $X$  is commonly used to estimate precision.

$$\sqrt{\frac{\sum_{i=1}^n (X - \bar{X})^2}{(n - 1)}}$$

where,

$X$  = the concentration

$n$  = times measured

$\bar{X}$  = the arithmetic mean.

##### 5.4.2. Relative Standard Deviation/Coefficient of Variation

The relative standard deviation (RSD), also referred to as the coefficient of variation (CV), is the expression of the standard deviation,  $s$ , as a percentage of the mean,  $\bar{X}$ . The RSD is useful in the comparison of replicates.

$$\text{RSD} = 100 (s / \bar{X})$$

#### 5.5. Methods Development

When standard (*i.e.* published) methods of analysis are not applicable to the analyses to be performed, methods are developed to achieve the desired

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information. The lack of a historical database does not preclude the necessity for documented quality control data to demonstrate the validity of the results. Traceable reference material sources identified with proof of compound purity and identity are used. Instrument operating parameters, calibration data, and specific procedures, including sampling, if applicable, are documented and closely controlled. Quality control samples (method blanks, laboratory control samples, laboratory control sample duplicates, matrix spikes, and matrix spike duplicates) are analyzed with a frequency not less than those specified in the standard methods to demonstrate a level of certainty for the generated data.

Exact requirements for demonstrating the reliability of developed methods are normally dictated by the specific program and overseen by the Laboratory Manager and the QA Manager.

#### **5.6. Other Method Requirements**

Method requirements vary with different programs. Reporting limits, QA/QC requirements, and required corrective actions are often dependent on the analytical protocol for a particular agency. In order to address the various requirements, please refer to the Appendices of this document.

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## ANALYTICAL PROCEDURES

### Section 6

#### 6.1. Analytical Methods Resources

PDP Analytical Services (PDP) has the capacity to analyze environmental samples for a full range of organic, metal, and general chemistry parameters in groundwater, surfacewater, soil, sediments, air, process waste, and other media. Most performed analyses are driven by regulatory concerns. Therefore, methods used at PDP predominantly originate from regulatory agencies such as the Environmental Protection Agency (EPA), state agencies, and professional organizations.

Generally, the methods used are the most recent updates of regulatory publications. The material is available for reference in the QA library. However, the reference materials are used to develop the Standard Operating Procedure (SOP) used by the laboratory analyst or technician during the analysis so constant referral to several sources is not necessary.

#### 6.2. Method Detection Limits (MDLs)

Method Detection Limits (MDLs) are obtained through experimental repetition to demonstrate accuracy, representativeness and proficiency of the analyst for a particular analytical method. All MDLs are calculated at least annually by the standard deviation of a run set for all analyses currently being performed at PDP.

#### 6.3. Reporting Limits

Each analytical method, adapted to a type of matrix, characterizes a low limit of detection or quantitation per analyte of interest through the determination of the low point of the calibration curve. This information is of particular use when the analysis of a sample does not yield a reportable concentration. PDP employs documented procedures during sample preparations and/or analysis to reduce or eliminate matrix interferences which may reduce instrument sensitivity, thereby raising reporting limits (RLs). By using screening methods (approximate

analytical concentrations) more accurate preparation and/or dilutions can be determined.

#### **6.3.1. Derivation of Reporting Limits**

The RLs used in a project are specified by the Quality Assurance Project Plan (QAPP) or the client contract. The specific project may utilize any of the RL determination methods outlined in 6.2.1.1. through 6.2.1.3.

- 6.3.1.1. Analyze duplicate aliquots of reagent water spiked with the analyte(s) of interest and statistically calculate the limits
- 6.3.1.2. Method detection limits (MDL) studies and / or instrument detection limit (IDL) studies which are performed at least annually for each instrument and applicable method.
- 6.3.1.3. Use the lowest calibration standard concentration that the instrument detects.

#### **6.3.2. List of Reporting Limits**

The current reporting limits for routine analyses can be found as an attachment to this document. While PDP makes every effort to reach these limits, it is imperative to note that they may not be achievable under some circumstances. The samples, despite interference treatment and precautions, may still be highly influenced by the matrix. (*See Attachment I: H, I, and J for current RL listings.*)

#### **6.4. Method Development and Validation**

The foundation for an analytical method (the process, reagents, instrumentation) comes from published methodologies having been validated by the successful performance of quality control standards. The documentation of laboratory implementation is through the SOPs which specify the quality control limits, the complete method process, and any deviations from the published, referenced methodology. (*See Section 5.4. for more information regarding method development.*)

#### **6.5. Other Method Requirements**

Various agencies and industries require routine deviations in the analytical methodologies to meet unique specifications. These requirements may be found in the appendices of this document.



## DATA REDUCTION, VALIDATION, AND REPORTING

### Section 7

#### 7.1. Data Generation

All analysts are responsible for the generation and reduction of analytical data. This is accomplished through extracting required information from laboratory worksheets, run logs, instrument printouts, and from making necessary calculations to reduce the data to its final reporting concentrations. This information is then reviewed by a peer analyst, and submitted to the section leader for approval. The data results are then entered into the computer database (LIMS).

#### 7.2. Data Validation

All analytical data generated at PDP Analytical Services (PDP) is checked for accuracy and completeness through a multi-tier review system. (*See Attachment I: K for schematic diagram of review process.*) Each Standard Operating Procedure (SOP) outlines the method-specific performance criteria, calculations, and documentation requirements which must be met for the data to be valid.

##### 7.2.1. Analyst

The analyst initiates the validation process by reviewing the data for completeness, accuracy, and QC performance. The review follows the organization found on the Data Review Checklist and Case Narrative form. (*See Attachment II: G for the data review form.*) If any errors are found, corrective action is undertaken as directed. (*See Section 12 for more specific information regarding corrective action procedures.*) The analyst certifies the data package and submits it for a Level I Technical Review by a peer analyst.

##### 7.2.2. Peer Review

The peer review is directed by the same form. The peer reviewer reviews the data for valid supporting documentation, correct calculations, and complete technical information. The peer reviewer also ensures that the

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Data Review Checklist was used by the analyst and that corrective actions, if necessary, were initiated. The peer reviewer signs the data and submits it to the section leader for a Level II Technical Review.

#### **7.2.3. Section Leader Review**

The section leader review is comprehensive and is performed by a section leader or designee deemed qualified. All aspects of proper documentation procedures, completeness of logsheets, adherence to holding times, and case narrative issues are noted. The QC sample validity and compliance with client requests are also checked at this time. Once the section leader or qualified designee has reviewed the data and the results from any necessary corrective actions, it is signed and submitted for data entry and the QC Coordinator review.

#### **7.2.4. QC Coordinator Review**

The QC review is similar to the section leader review with more emphasis being placed on QC criteria being met and corrective actions having been completed. The QC Coordinator is also responsible for the review of final results for discrepancies with the raw data and the logsheets.

Upon approval, the QC Coordinator authorizes the report generation clerks to prepare the final report and submit it to the Project Manager.

#### **7.2.5. Project Manager Review**

The review of the report performed by the Project Manager may follow the Final Report Review Checklist. (*See Attachment II: H for the final report review checklist form.*) The review includes, but is not limited to, ensuring that client requests were completed, the order and legibility of the report are acceptable, that all levels of the review were documented, and that the final report agrees with the raw data.

Once approved, the project letter is signed and the report package is submitted to the client.

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**7.2.5. QA Manager Review**

The QA Manager addresses technical questions for all episodes during the analytical process. The resolutions or observations may formally be discussed through the use of a Corrective Action Report (CAR) or the Case Narrative.

Each episode is reviewed at a ten percent (10%) level to ensure that all quality steps were followed while the episode was being processed by the laboratory. This review may occur after submission to the client.

In addition, the QA Manager completely reviews ten percent (10%) of the reports, after submission to the client, for project completeness and general quality adherence. This includes a comparison of the chain of custody requests to the actual test parameters reported by the laboratory, a technical assessment of the data relationships, the completeness and validity of the case narrative, resolution of corrective actions, and the acceptability of the methods.

If any issues or errors are found by the QA Manager during a review, corrective action is initiated. If necessary, the client is notified and will receive an appropriate addendum to the report. The corrective action will also serve as the initiation to prevent future occurrences.

**7.3. Report Contents**

A variety of reporting formats, from data tables to CLP packages, are available. In general, however, a PDP report consists of a project cover letter, a case narrative, client information for identification purposes, the analytical data with reporting limits, QC samples, and methodology references. A set of pertinent raw data will be provided for all report packages upon request.

## QUALITY CONTROL CHECK METHODS

### Section 8

Quality Control (QC) is the quantitative measurement of any system of interest through an assessment of precision and accuracy. For laboratories, a QC program provides a means of checks and balances through a systematic process, via accuracy and precision measurements of analytical data. There are external and internal factors which influence precision and accuracy.

#### 8.1. External Quality Control

The analysis of field QC samples provides the most complete assessment of precision and accuracy of environmental samples since they are exposed to the same circumstances as the client samples. Field QC samples undergo the same treatment as client samples from sample collection through analysis and data reduction.

##### 8.1.1. Equipment Blank

An equipment blank is a demonstration of accuracy. It is typically deionized water poured over or through sampling equipment after decontamination or sterilization and before sample collection. The equipment blank detects contamination present on the sampling equipment which may have been introduced into the actual samples.

##### 8.1.2. Trip Blank

A trip blank is a demonstration of accuracy. It is typically deionized water submitted by the laboratory to the project site with the sampling containers (usually one per cooler). Once the samples are collected, the trip blank is submitted unopened to the laboratory with the actual samples (again, usually one per cooler). The trip blank provides a means to measure any cross-contamination which may occur during sample transport. Volatile organic compounds are the most migratory compounds and are typically the specified analysis for trip blanks.

### 8.1.3. Field Blank

A field blank is a demonstration of accuracy. It is typically deionized water exposed to the project site environment. The field blank detects contamination present in the area surrounding the sampling site. This contamination may have been introduced into and affected the actual samples.

### 8.1.4. Field (Sample) Duplicate

A sample duplicate is a demonstration of precision. This sample is a repetitive sample that may be taken as a separate aliquot at the same sampling site or a larger sample split in two. The duplicate measures the representativeness of the sample results for that project site location and the efficiency of the sampling techniques.

## 8.2. Internal Quality Control (Laboratory QC)

QC samples prepared and analyzed in the laboratory provide precision and accuracy results to laboratory personnel to assess the efficiency of the preparation and analytical protocols. This is accomplished, for example, through the analysis of method blanks, laboratory control samples, sample duplicates, and matrix spikes. Each method requires different QC samples at particular frequencies. *(See Attachment I: L for a listing of required QC samples and their frequency by routine test.)* Internal factors such as laboratory contamination, poor preparation and extraction technique, or degraded standards can contribute to laboratory performance, especially accuracy and precision. The acceptance limits of the QC samples helps to pinpoint what type of deficiency may exist which allows corrective actions to be tailored and, therefore, more effective. *(See Attachment I: M, N, and O for a listing of routine acceptance criteria by parameter.)*

### 8.2.1. Method Blank

8.2.1.1. The method blank is generated by treating Type II reagent water, sodium sulfate, or a clean solid matrix in the same manner as the samples throughout the complete analytical process. The method blank demonstrates the potential level of contamination in the samples caused from solvents, reagents, glassware, or other laboratory equipment. Method

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blanks are included with each batch of no more than twenty (20) samples.

- 8.2.1.2. Reagent verification can be made by reviewing the method blank. If the method blank shows no contamination, it can be deduced that the reagent, which was added to the method blank, is not compromised.

#### 8.2.2. Laboratory Control Sample (LCS)

Laboratory control samples (LCS) are generally deionized water, sodium sulfate, or a clean solid matrix spiked with known amounts of target analytes. The resulting recovery demonstrates accuracy. When analyzed in duplicate (LCSD), the difference between the percent recoveries (%R) monitors the precision of the test.

#### 8.2.3. Spiked Sample (Matrix Spike)

The matrix spike (MS) is an aliquot of an actual sample with specific amounts of target analytes added. The data result measures the accuracy for the test in the particular matrix. When analyzed in duplicate (MSD), the percent recoveries (%R) monitor the precision of the test for the sample matrix. Although MS and MSD are used for QC purposes, the demonstrated accuracy and precision is only completely applicable to the associated sample.

#### 8.2.4. Sample Duplicate

The sample duplicate is a repeated analysis on a portion of a sample. The sample duplicate is generally prepared and analyzed separately to demonstrate and monitor intralaboratory precision in regards to the generated data.

#### 8.2.5. Surrogate Standards

Surrogate standards are analyzed during organic analysis as a measurement of accuracy in accordance with USEPA guidelines. Method specified standards are added and analyzed with the samples to ensure recovery of all compounds of interest. Surrogates are added to all

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samples, method blanks, LCS, and matrix spikes undergoing organic analyses.

#### **8.2.6. DFTPP Criteria Test**

The DFTPP criteria test is utilized during the GC/MS analysis prior to Base/Neutral/Acid Fraction analysis. The instrument is calibrated according to USEPA protocol by injecting Decafluorotriphenylphosphine (DFTPP) and comparing the relative ion abundances for key ions. The instrument is to be calibrated until all criteria are met as demonstrated through the DFTPP sample test results.

#### **8.2.7. BFB Criteria Test**

The BFB criteria test is utilized daily to check the performance of the GC/MS system before VOA analysis. The instrument is injected with Bromofluorobenzene (BFB) and the relative abundances of key ions are compared. The instrument is to be adjusted until all criteria are acceptably demonstrated through the BFB test.

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## DATA QUALITY STANDARDS

### Section 9

The QA program at PDP Analytical Services (PDP) is measured by the quality of the data generated by the laboratory. Data quality is judged in terms of its precision, accuracy, representativeness, completeness, and comparability.

#### 9.1. Accuracy

Accuracy is a determination of how similar the measurement is to the true value, and it, therefore, reflects the total correctness of the reported results. Accuracy is assessed using laboratory control samples and their duplicates (LCS and LCSD), matrix spikes and their duplicates (MS and MSD), and reference materials. Laboratory accuracy is statistically measured in terms of percent recovery (%R) and is defined by the specific method being utilized.

##### 9.1.1. Percent Recovery (%R) for LCS

$$\left[ \frac{X_m}{X_t} \right] \left[ 100 \right] ;$$

where,

$X_m$  = the measurement found by analysis

$X_t$  = the true measurement



**9.1.2. Percent Recovery (%R) for MS**

$$\left[ \frac{X_s - X_u}{A} \right] \left[ 100 \right] ;$$

where,

$X_s$  = value of the compound found in the sample by analysis after spiking

$X_u$  = value of the compound in the sample before spiking

A = amount of spike added to the sample

**9.2. Precision**

Precision is the degree to which the measurement is reproducible. Precision is assessed by the duplicate measurements of matrix spikes (MS and MSD), laboratory control samples (LCS and LCSD), or the analysis of reference materials. The precision, statistically shown by the relative percent difference (RPD), must meet the specified method requirements to be considered acceptable.

**9.2.1. Relative Percent Difference (RPD)**

In the case of sample duplicates, the RPD between the two samples may be used to estimate precision.

$$\frac{|D_1 - D_2|}{\overline{D}} (100) ;$$

where,

$D_1$  = the first sample value

$D_2$  = the duplicate sample value

$\overline{D}$  = the arithmetic mean of the two values

**9.3. Representativeness**

Representativeness is the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Analytical data should represent the sample analyzed regardless of the heterogeneity of the original sample matrix.

PDP strives to accommodate all sample matrices. Some samples may require the analysis of multiple phases to obtain representative results.

**9.4. Completeness**

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount expected to be obtained under normal conditions. To be considered complete, the data set must contain all QC analyses which verify the precision and accuracy of the analytical protocol. In addition, all data are reviewed in terms of stated criteria in order to determine if the data are sufficient. PDP strives to maintain a completeness of goal of 95%.

**9.5. Comparability**

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured through the use of established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, *etc.*), consistency of reporting units, and the repetitive analysis of reference materials with low RDP.

## **AUDITS**

### **Section 10**

PDP Analytical Services (PDP) is committed to successfully participate in a variety of federal and state certification programs which regularly subject the laboratory to stringent system and performance audits.

#### **10.1. Systems Audits**

A systems audit is a review of laboratory operations conducted to verify that the laboratory has the necessary facilities, equipment, staff, and procedures in place to generate acceptable data. This type of audit is conducted by agencies, clients, and the QA Manager.

##### **10.1.1. Specific Investigations**

- 10.1.1.1. Verify testing procedures
  - a. Compliance with method requirements
  - b. Compliance with current SOPs
  - c. Able to easily perform routine tests associated with client contracts
- 10.1.1.2. Verify facilities and testing equipment
  - a. Readily available
  - b. Ensure well maintained and in proper working order
- 10.1.1.3. Compare instrument calibration data against certified reference standards
- 10.1.1.4. Verify logbooks and other test documentation forms are being properly maintained

##### **10.1.2. Frequency**

The QA Manager conducts a formal systems audit quarterly. The audit findings and recommendations are provided to the President and Laboratory Manager in a written report. Operational improvements, if necessary, will be initiated by the Laboratory Manager; necessary

administrative and/or facility improvements will be initiated by the President.

## **10.2. Performance Audits**

A performance audit verifies the ability of the laboratory to correctly identify and quantify compounds in blind check (PE) samples or routine QC samples.

### **10.2.1. Measurement Parameter Performance Audits**

Parameter measurements are conducted with every batch of samples through the analysis of QC samples. These results are reviewed by analysts to ensure specific sample acceptance.

Control charts are maintained and reviewed, at least annually, by the QA Manager to ensure the integrity of the testing process. This part of the measurement parameter audit may also be used to detect fluctuation trends so successful corrective actions may be developed.

### **10.2.2. Performance Evaluation (PE) Studies**

#### **10.2.2.1. Participation**

PDP participates in EPA proficiency studies. The Water Pollution and Water Supply studies are submitted semi-annually. (*See Attachment I: P and Q for the tested target analyte categories.*) PDP also participates, as warranted, in proficiency evaluation studies conducted by other agencies and private industries.

#### **10.2.2.2. Results**

All unacceptable results are submitted to section leaders who investigate the occurrence. The reports submitted by the section leaders to the QA Manager are summarized and presented to the President and the Laboratory Manager with recommendations.

## MAINTENANCE

### Section 11

#### 11.1. Preventative Maintenance

Preventative maintenance tasks are routinely performed to minimize the possibility of production downtime.

##### 11.1.1. Instrumentation

All instrumentation is periodically subjected to the preventative maintenance tasks outlined in the respective operations manual. (*See Attachment I: R for the preventative maintenance schedule.*) All major instruments have manufacturer service contracts.

##### 11.1.2. General Chemistry

Glassware is kept in a clean and ready-to-use condition. The glassware and equipment in use are routinely examined for safety and replacement determination.

#### 11.2. Documentation

Minor maintenance is recorded in the analysis runlog; major maintenance is recorded in the appropriate Instrument Maintenance Logbook. The contract service receipts are maintained by each section leader.

#### 11.3. Spare Parts and Supplies

Each laboratory is stocked with spare parts and supplies to facilitate preventative maintenance, small equipment replacement, and expedite repairs. These supplies include, but are not limited to, extra glassware, columns, septa, lamps, pump hoses, filters, injection port liners, and surplus reagents. Local supplier information is also maintained for emergency ordering.

## CORRECTIVE ACTION

### Section 12

#### 12.1. Necessity

Corrective actions may be necessary if performance criteria are not met during intralaboratory interactions. All personnel are required to conform to written QC criteria and corrective action procedures. Performance criteria are specified in methodologies, client contracts, and SOPs.

##### 12.1.1. Common Causes

- 12.1.1.1. QC data outside the acceptable windows for precision and accuracy
- 12.1.1.2. Method blank contains contaminants
- 12.1.1.3. Deficiencies are detected during systems or performance audits
- 12.1.1.4. Client-initiated inquiries of data quality
- 12.1.1.5. Undesirable trends in QC data quality

#### 12.2. Process

##### 12.2.1. Laboratory Duties

Corrective action procedures are initiated by the person detecting a failure in meeting the performance criteria of the data. The person submits a corrective action report (CAR), with recommendations, to the appropriate section leader. (*See Attachment II: I for a copy of the corrective action report.*) A copy of the form is also submitted to the QA Manager for review and assignment of a tracking number.

The section leader reviews the appropriateness of the recommended action and, if necessary, assigns the corrective action task to the appropriate personnel within the department. Upon successful completion, the original CAR is routed to the QA Manager for final approval.

**12.2.2. QA Manager Duties**

The QA Manager reviews the problem and the intended correction. The QA Manager maintains the authority to alter the proposed action as necessary. If a delay in turn-around-time is expected, the QA Manager notifies the Project Manager so the client can be informed of the on-going corrective action. Upon completion of the task, the QA Manager reviews the final data for validity, determines if there are possible preventative actions for future situations, and places a copy of the completed CAR in the permanent episode file(s). The original CAR is kept in the QA files.

## LABORATORY DOCUMENTATION AND MANUALS

### Section 13

#### 13.1. Standard Operating Procedures (SOPs)

SOPs are controlled documents containing detailed information regarding a laboratory procedure or protocol. Specific analytical requirements and QC criteria used to develop the SOP are gathered from a combination of approved methodologies, reference literature, and practical experience. A copy of pertinent SOPs must be in a designated controlled notebook in the general area of the task performance for reference.

##### 13.1.1. Categories

All SOPs follow a specified format of presentation. (*See Attachment I: S for an outline of a standard SOP and the pertinent QA SOP for procedural details.*) Some categories will require the modification of the outline to indicate sections which are not applicable.

##### 13.1.1.1. Organic

SOPs for the performance of an organic analytical method, instrument operation, or sample preparation are assigned document identification numbers sequentially from 1000 with the following format: PDP1000 - Revision {#} and a method description.

##### 13.1.1.2. Metals

SOPs for the performance of a metal analytical method, instrument operation, or sample preparation are assigned document identification numbers sequentially from 2000 with the following format: PDP2000 - Revision {#} and a method description.

##### 13.1.1.3. Wet Chemistry

SOPs for the performance of a general chemistry analytical method, instrument operation, or sample preparation are assigned document identification numbers sequentially



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from 3000 with the following format: PDP3000 - Revision {#} and a method description.

**13.1.1.4. Quality Assurance**

SOPs for the data review process and performance assurance are assigned document identification numbers sequentially from 4000 with the following format: PDP4000 - Revision {#} and a method description.

**13.1.1.5. Safety**

SOPs detailing employee health and safety procedures and safeguards are assigned document identification numbers sequentially from 5000 with the following format: PDP5000 - Revision {#} and a method description.

**13.1.1.6. Miscellaneous Laboratory Operations**

SOPs detailing sample handling and general laboratory procedures are assigned document identification numbers sequentially from 6000 with the following format: PDP6000 - Revision {#} and a method description.

**13.1.1.7. Administration**

SOPs detailing business and client interactions are assigned document identification numbers sequentially from 7000 with the following format: PDP7000 - Revision {#} and a method description.

**13.1.1.8. Systems Management**

SOPs detailing the use and development of software and computer hardware are assigned document identification numbers sequentially from 8000 with the following format: PDP8000 - Revision {#} and a method description.

**13.2. Laboratory Logbooks**

All preparation, extraction, and analytical information is recorded in bound logbooks. Any unusual observations regarding the samples or resulting data are noted in the comments section. All logbooks are initialed and dated by the analyst at the time of analysis.

The section leaders periodically review completed laboratory logbooks pages. Completed logbooks are submitted to the Document Control Officer for filing. The QA Manager reviews current and archived laboratory logbooks during

audits to ensure adherence to method protocols and documentation requirements.  
(See Section 10.1. for information regarding audit requirements.)

### **13.3. Internal Manuals**

PDP Analytical Services (PDP) has compiled several training manuals and papers such as SOPs and this document, the Quality Assurance Plan (QAP). Internal manuals utilize many sources of information and strive to present a concise and easily utilized tool. These controlled documents are subjected to periodic reviews and are maintained by the QA Manager. (See Section 13.5. for details regarding frequency and documentation.) Copies and updates are made available to all employees or interested clients. However, any copies in the possession of the employee at the end of employment, must be returned to the QA Manager.

### **13.4. Control Charts**

Control charts are used to identify trends in analyses which may indicate a problem with an analytical procedure or instrument by visually monitoring the LCS precision and accuracy data. PDP is improving its ability to generate control charts directly from the LIMS. The automatic generation of these reports will allow the analyst to monitor the procedure more closely than is currently done in the periodic reviews by the QA Manager. If an adverse trend is detected, either by the analyst or the QA Manager, the analysis will be suspended until proper corrective action has been completed.

### **13.5. Review and Revision Procedures**

All controlled documents are reviewed by the appropriate section leader and QA Manager no less than once per year. The review is documented on the original cover sheet. Revisions to the document, if necessary, are made at this time.

Current copies and updates are distributed to all laboratory SOP notebooks, as well as, individuals and organizations maintaining working copies.

## **TRACKING AND CONTROL PROCEDURES**

### **Section 14**

#### **14.1. Record Control Number System**

All controlled documents at PDP Analytical Services are issued a unique record control number (RCN) for tracking. This number is assigned just prior to transfer from the Document Control Officer or designee to the requesting party. Assigned numbers and identification information are recorded in the RCN logbook.

The Document Control Officer maintains the filing and archival of all PDP documents, reports, and manuals in a designated archive room for ten years. The RCN is retired upon return of the document by recording the return date in the RCN logbook. Access to the archive area is restricted. Logbooks are used to inventory all material, as well as, authorize the temporary removal of material.

#### **14.2. Raw Data**

Raw Data is filed with the pertinent episode in the archive room. Should overlap of QC sample data occur, copies will be filed in all the episodes for easy review of the entire episode. Access to the archive area is restricted. Logbooks are used to inventory all episodes, as well as, authorize the temporary removal of material.

## QUALITY ASSURANCE MONITORING

### Section 15

#### 15.1. Monthly Reports

The QA Manager prepares a formal report on the QA/QC issues, including Health and Safety, monthly. (*See Attachment I: T for an outline of the monthly QA report.*) The report covers occurrences from the previous month and outlines specific duties for the current month. The information in the report is gathered through informal and formal audits, report reviews, communication within the laboratory, and corrective action report reviews.

The QA monthly report is due to the President and Laboratory Manager by the fifth of the month with a review meeting to follow soon thereafter. The meeting will clarify details, adjust goals, and, if necessary, prescribe corrective action.

#### 15.2. Quality Assurance Program Review

The review of the QA program is mainly the duty of the QA Manager who reports the effectiveness in the monthly report. However, the adequacy and continued relevance of the program is assessed by each employee. Therefore, a successful assessment of the QA Program at PDP must address all opinions. Recommendations for enhancing quality, safety, or documenting procedures are encouraged. Such possible improvements may be directed to the QA Manager.

#### 15.3. Informal Audit Monitoring

The QA Manager informally audits one laboratory section a week to ensure continued compliance and improvement from the last formal [quarterly] audit. (*See Section 10 for information regarding formal audits.*) Informal audit reports are submitted as part of the QA Monthly Report outlined in 15.1.

## **ATTACHMENT I**

### **PDP DESCRIPTIVE TABLES AND FIGURES**

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Attachment I

Figure A. PDP Laboratory Floorplan

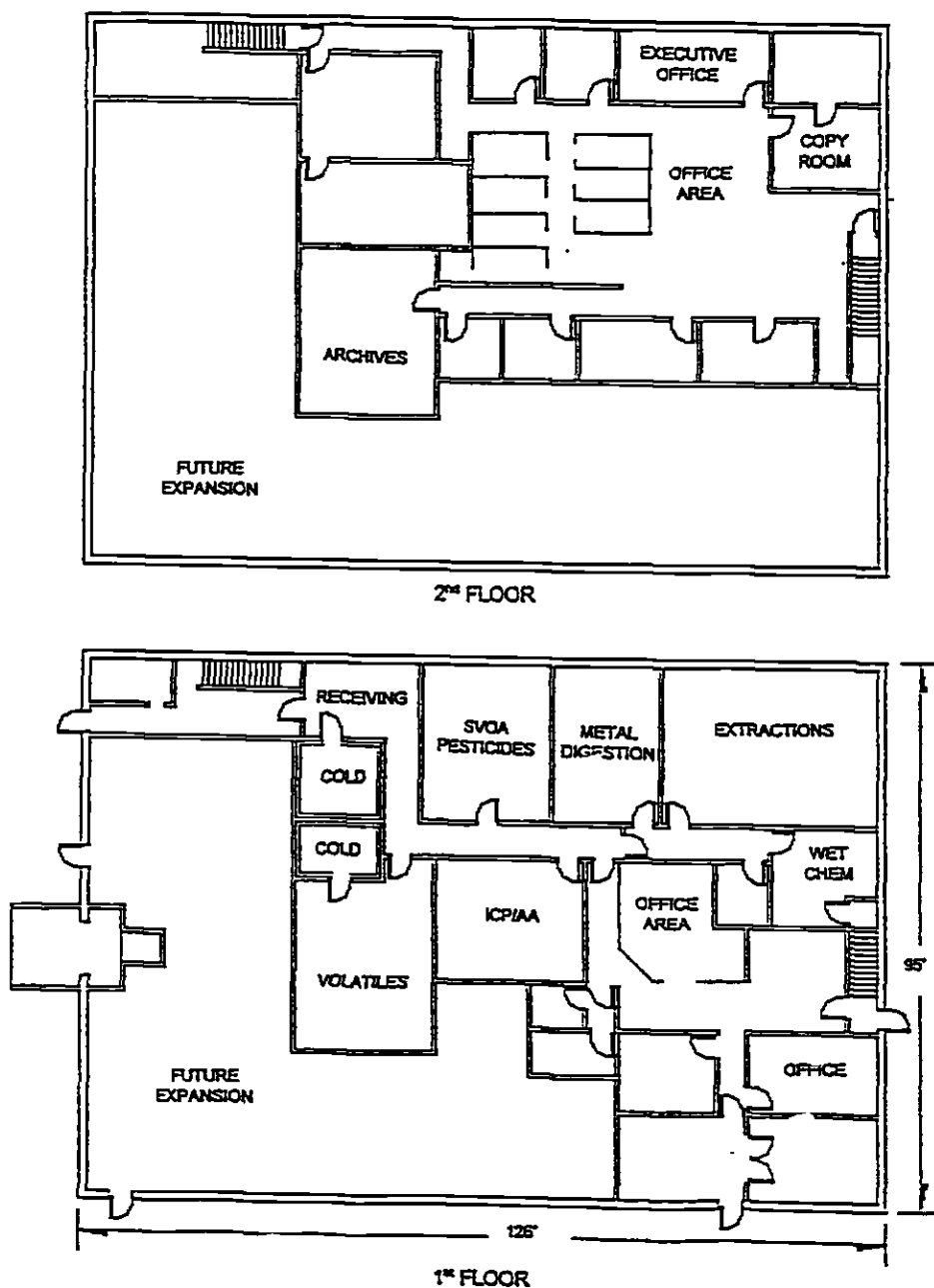


Table B. PDP Select Organic Instrumentation and Equipment List

Description	Model	Manufacturer	Quantity
Allometric balance	N/A	O Haus	1
Analytical balance	N/A	AND	1
Analytical balance	N/A	O Haus	1
Auto absorbance prep	1002B	GPC/A-ABC1002B	1
Autosampler controller/tray	18596B	N/A	3
Autosampler controller/tray	18594B	N/A	4
Autosampler controller/tray	G1512A	N/A	2
Autosampler controller/tray	18596M	N/A	2
Autosampler	5100	Archon	1
Autosampler Injection Tower	18593B	N/A	9
Conductivity detector	CDM-2	Dionex	1
Continuous liquid extractors - glass	N/A	HGF	10
ELCD	4420ELC	N/A	1
Fluorescence detector	FP-920	Dionex	1
Gas Chromatograph (GC)	5890 II	Hewlett-Packard	3
Gas Chromatograph (GC)	5890A II	Hewlett-Packard	2
Gas Chromatograph (GC)	5890E II	Hewlett-Packard	1
GC/dual column EPC/ECD	5890E II	Hewlett-Packard	1
GC/dual column EPC/ECD	5890A II	Hewlett-Packard	1
GC/dual column FID/NPD	5890A II	Hewlett-Packard	1
GC/dual split spittles/dual ECD	5890 II	Hewlett-Packard	1
GC column (extra)	11340	Restek	1
GC column (extra)	11140	Restek	1
Heating mantles	TM106	N/A	18
Gradient Pump	A/P-1	Dionex	1
Individual sample sonicators/probes	C-3	N/A	1
Individual sample sonicators/probes	CV17	N/A	1
Injector	LCM	N/A	1
Magnetic stirrers	1205	N/A	8
Mass Spectrometer	5970B	Hewlett-Packard	1
Mass Spectrometer	5971A	Hewlett-Packard	2
Mass Spectrometer	5972	Hewlett-Packard	1
Multi-sample water bath	N/A	Blue M Co.	2
Narrow neck bottles (500 mL)	N/A	N/A	22
pH meter	320	Corning	1
PID	4430RD	N/A	1

Table B. Concluded.

Description	Model	Manufacturer	Quantity
Seperatory funnel (glass)	N/A	N/A	20
Seperatory funnel (polyethylene)	N/A	N/A	25
Sonicator	W-385	Ultrasonics, Inc.	1
Sonicator	SC-40	Sonico	1
Sonicator/sonic disrupter	T-90-375	Tekmar	1
Stirrer/hotplate	N/A	Corning	2
Suppresser	ARS-1	Dionex	1
Suppresser Controller	SRC-1	Dionex	1
Test tubes (autosampler size)	45060-1950	Kimble	200
Total Hydrocarbon Analyzer	404	A-Buck404	1
Tri-head round flask (with mantle) - 4L	N/A	N/A	1
Tubing (various)	N/A	N/A	N/A
TurboVap II	N/A	Zymark	2
UV detector	VDM-2	Dionex	1
Vortex	G-560	Genie-2	1
ZHE set-ups	N/A	N/A	12



Table C. PDP Select Inorganic Instrumentation and Equipment List

Description	Model	Manufacturer	Quantity
Analytical Balance	B-A110	O Haus	1
Beakers (various sizes)	N/A	N/A	N/A
Burettes (various sizes)	N/A	N/A	3
Clay Separatory Funnel (TSS funnel)	N/A	N/A	4
COD tubes	N/A	N/A	70
Dessicators (large)	N/A	Sanplate Corp.	6
Disposable graduated pipettes (various)	N/A	N/A	ca. 3 cases
Distilling glassware set-ups	N/A	HGF	25
Drying ovens	N/A	N/A	4
Erlenmeyer flasks (various sizes)	N/A	N/A	90
Filtrating flasks (250 mL)	N/A	N/A	12
Filtrating flasks (800 mL)	N/A	N/A	5
Flow analyzer	N/A	Perstorp	1
GFAA	4100ZL	Perkin-Elmer	1
GFAA	FA188	Thermal Jarrel Ash	1
Graduated cylinders (various)	N/A	N/A	25
Funnels -glass (various)	N/A	N/A	40
Funnels - polyethylene (medium)	N/A	N/A	25
Hot bath	N/A	N/A	1
Hot Block	N/A	Environ. Express	1
ICP Optima	3000XL	Perkin-Elmer	1
Laboratory mixer	50002-10	Stirpak	1
Mercury analyzer	A-BUCK400A	Buck	1
pH meter	520A	Orion	1
Pipettes - repeater (various ranges)	N/A	N/A	5
Propane lighter	TS-2000	Benzomantic	2
Spectrophotometer	Spec 20	Bausch & Lomb	1
Spectrophotometer	Spec 401	Milton Roy	1
Standard precision balance	TS4005	O Haus	1
Stir plates	1205	Fisher	2
Stirrer/hotplate	N/A	Fisher	1
Teardrop flasks (various)	N/A	N/A	10
Test tubes	9820	Pyrex	30
Total Organic Carbon analyzer	700	OI Corp.	1
Vacuum pump	E2M2	N/A	1

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Attachment I

Table D. PDP Select General and Systems Support Instrument and Equipment List

Description	Model	Manufacturer	Quantity
Air compressor system	N/A	N/A	1
Data system	ACJ-1	VG Server	1
Deionized water system	N/A	N/A	2
HP Series Computer & Accessories	1000-A900	Hewlett Packard	1
Instrument and analysis chillers	N/A	N/A	4
Integrator	3364	Spectraphysics	1
Mechanical lift (small)	N/A	Fisher	1
Personal Computers	N/A	Gateway	29
Printers - dot matrix	N/A	N/A	11
Printers - laser	N/A	Hewlett Packard	3
Printers - laser	N/A	Canon	1
Refrigerators - regular	N/A	N/A	7
Refrigerators - walk-in	N/A	N/A	2

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## Attachment I

Table E. Containers, Preservatives, and Holding Times for Aqueous Samples

Name	Containers <sup>1</sup>	Preservative	Holding Time <sup>2</sup>
<b>Bacterial</b>			
Coliform (Total/Fecal)	P, G - 200 mL	4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	6 hours
Streptococci (Fecal)	P, G - 250 mL	4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	6 hours
<b>Inorganics (wet chemistry)</b>			
Acidity	P, G - 250 mL	4°C	14 days
Alkalinity	P, G - 250 mL	4°C	14 days
Ammonia	P, G - 1000 mL	4°C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Biological Oxygen Demand (BOD)	P, G - 1000 mL	4°C	48 hours
(Carbonaceous) Biological Oxygen Demand (CBOD)	P, G - 1000 mL	4°C	48 hours
Bromide	P, G - 500 mL	none required	28 days
(Total Organic) Carbon (TOC)	P, G - 500 mL	4°C; HNO <sub>3</sub> or H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Chemical Oxygen Demand (COD)	P, G - 500 mL	4°C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Chloride	P, G - 500 mL	none required	28 days
(Total Residual) Chlorine	P, G - 500 mL	none required	analyze immediately
Color	P, G - 500 mL	4°C	48 hours
Conductivity (Specific Conductance)	P, G - 500 mL	4°C	28 days
(Reactive) Cyanide	P, G amber - 1000 mL	none required	analyze immediately
Cyanide (Total and Amenable to Chlorination)	P, G - 1000 mL	4°C; NaOH to pH>12; 0.6g ascorbic acid	14 days
Fluoride	P - 500 mL	none required	28 days
Hardness	P, G - 250 mL	HNO <sub>3</sub> or H <sub>2</sub> SO <sub>4</sub> to pH<2	6 months
Nitrate	P, G - 250 mL	4°C	48 hours
Nitrate-Nitrite	P, G - 250 mL	4°C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Nitrite	P, G - 250 mL	4°C	48 hours
(Total Kjeldahl) Nitrogen	P, G - 1000 mL	4°C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Oil and Grease	G - 1000 mL	4°C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days

Table E. Continued.

Name	Containers <sup>1</sup>	Preservative	Holding Time <sup>2</sup>
<b><i>Inorganics (wet chemistry) concluded</i></b>			
Oxygen (Dissolved Probe)	G bottle & top - 250 mL	none required	analyze immediately
Oxygen (Winkler)	G bottle & top - 500 mL	fix on site; store in the dark	8 hours
pH (hydrogen ion)	P, G - 250 mL	none required	analyze immediately
(Total) Phenols (wet method)	G - 1000 mL	4°C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
(ortho-) Phosphate	P, G - 250 mL	filter immediately; 4°C	48 hours
(Total) Phosphate	P, G - 250 mL	4°C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Residue (Total Solids)	P, G - 500 mL	4°C	7 days
Residue (Dissolved Solids) (TDS)	P, G - 500 mL	4°C	7 days
Residue (Suspended Solids) (TSS)	P, G - 500 mL	4°C	7 days
Residue (Settleable)	P, G - 1000 mL	4°C	48 hours
Residue (Total Volatile) (TVS)	P, G - 500 mL	4°C	7 days
Residue (Volatile Suspended) (TVSS)	P, G - 500 mL	4°C	7 days
Silica	P - 500 mL	4°C	28 days
<b><i>Metals</i></b>			
Chromium VI	P, G - 1000 mL	4°C	24 hours
Mercury	P, G - 1000 mL	HNO <sub>3</sub> to pH<2	28 days
Metals (except Chromium IV and Hg)	P, G - 1000 mL	HNO <sub>3</sub> to pH<2	6 months
TCLP Mercury	P, G - 1000 mL	4°C	28 days to extraction; 28 days after extraction to analysis
TCLP Metals (except Mercury)	P, G - 1000 mL	4°C	180 days to extraction; 180 days after extraction to analysis

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Table E. Concluded.

Name	Containers <sup>1</sup>	Preservative	Holding Time <sup>2</sup>
<b>Organics</b>			
Acrolein and Acrylonitrile	G bottle with Teflon-lined septum - 40mL (2)	4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> ; adjust pH to 4-5	14 days
Dioxins (TCDD)	G bottle with Teflon-lined lid - 1000 mL	4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	7 days to extraction; 40 days after extraction to analysis
Pesticides/PCBs (Organochlorine)	G bottle with Teflon-lined lid - 1000 mL	4°C; adjust pH to 4-5	7 days to extraction; 40 days after extraction to analysis
(Total) Petroleum Hydrocarbons (TPH)	G - 1000 mL	4°C; HCl to pH<2	28 days
Polynuclear Aromatic Hydrocarbons (PAHs)	G bottle with Teflon-lined lid - 1000 mL	4°C	7 days to extraction; 40 days after extraction to analysis
Semi-Volatiles (BNAs)	G bottle with Teflon-lined lid - 1000 mL	4°C	7 days to extraction; 40 days after extraction to analysis
Semi-Volatiles (TCLP)	G bottle with Teflon-lined lid - 1000 mL	4°C	14 days to TCLP extraction; 7 days from TCLP extraction to BNA extraction; 40 days after BNA extraction to analysis
Total Organic Halogens (TOX)	G bottle with Teflon-lined lid - 1000 mL	4°C; H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Volatiles	G bottle with Teflon-lined septum - 40 mL (2)	4°C; HCl to pH<2	14 days
Volatiles (TCLP)	G bottle with Teflon-lined septum - 40 mL (2)	4°C	14 days to extraction; 14 days after extraction to analysis
<b>Radiological</b>			
Alpha, Beta, and Radium	P, G - 1000 mL	HNO <sub>3</sub> to pH<2	6 months

<sup>1</sup> (P) polyethylene/plastic; (G) Glass<sup>2</sup> Recommended Holding Times from 40CFR136 and/or USEPA SW-846.

Table F. Containers, Preservatives, and Holding Times for Solid Samples

Name	Containers <sup>1</sup>	Preservative	Holding Time <sup>2</sup>
<b>Metals</b>			
TCLP Mercury	P, G wide mouth - 120 mL	4°C	28 days to extraction; 28 days after extraction to analysis
TCLP Metals (except Mercury)	P, G - 1000 mL	4°C	180 days to extraction; 180 days after extraction to analysis
<b>Organics</b>			
Acrolein and Acrylonitrile	G wide mouth with Teflon-lined septum - 120 mL	4°C	14 days
Dioxins (TCDD)	G wide mouth with Teflon-lined lid - 250 mL	4°C	14 days to extraction; 40 days after extraction to analysis
Pesticides/PCBs (Organochlorine)	G wide mouth with Teflon-lined lid - 250 mL	4°C	14 days to extraction; 40 days after extraction to analysis
Polynuclear Aromatic Hydrocarbons (PAHs)	G wide mouth with Teflon-lined lid - 250 mL	4°C; store in the dark	14 days to extraction; 40 days after extraction to analysis
Semi-Volatiles (BNAs)	G wide mouth with Teflon-lined lid - 250 mL	4°C	14 days to extraction; 40 days after extraction to analysis
Semi-Volatiles (TCLP)	G wide mouth with Teflon-lined lid - 250 mL	4°C	14 days to TCLP extraction; 7 days from TCLP extraction to BNA extraction; 40 days after BNA extraction to analysis
Total Organic Halogens (TOX)	G wide mouth with Teflon-lined lid - 120 mL	4°C	28 days
Volatiles	G wide mouth with Teflon-lined septum - 120 mL	4°C	14 days
Volatiles (TCLP)	G wide mouth with Teflon-lined septum - 120 mL	4°C	14 days to extraction; 14 days after extraction to analysis

<sup>1</sup> (P) polyethylene/plastic; (G) Glass

<sup>2</sup> Recommended Holding Times from 40CFR136 and/or USEPA SW-846.

Table G. Refrigerator Identifications and Contents

Refrigerator	Location	Contents
A	Volatiles Lab (Walk-in)	Volatile samples (including CLP)
B	Semi-Volatiles/GC Lab	Semi-Volatile extracts; In-progress CLP semi-volatile extracts; (freezer) semi-volatiles standards
C	Wet Chemistry Lab	Wet chemistry standards & reagents
D	Volatiles Lab	Volatile standards; (freezer) CLP standards
E	Volatiles Lab	Non-CLP volatiles standards
F	Semi-volatiles/GC Lab	Pesticides/Herbicides/TPH-Diesel extracts; In-progress CLP Pesticides / Herbicides extracts; (freezer) GC standards
G	Volatiles Lab	Non-CLP volatiles standards
H	General Chemistry Lab	Organic extractions overflow; Non-CLP extracts; (freezer) organic extractions standards and reagents
I	Sample Receiving (Walk-in)	Samples (freezer) CLP archived extracts

Table H. Routine Organic Reporting Limits

Parameter	Aqueous (µg/L)	Solid (µg/Kg)
<b>Method 8015B - TPH Diesels and Gasolines</b>		
Diesel Range	250	8250
Gasoline Range	250	250
<b>Method 8021B - BTEX</b>		
Benzene	5	625
1,2-Dichlorobenzene	5	625
1,3-Dichlorobenzene	5	625
1,4-Dichlorobenzene	5	625
Ethylbenzene	5	625
Methyl- <i>tert</i> -Butyl-Ether	20	2500
Toluene	5	625
Xylenes	5	625
<b>Method 8081A - Pesticides/PCBs</b>		
4,4' - DDD	0.10	3.3
4,4' - DDE	0.10	3.3
4,4' - DDT	0.10	3.3
Aldrin	0.05	1.7
<i>alpha</i> - BHC	0.05	1.7
<i>beta</i> - BHC	0.05	1.7
<i>delta</i> - BHC	0.05	34
<i>gamma</i> - BHC	0.05	1.7
Chlordane	1.00	3.3
Dieldrin	0.10	1.7
Endosulfan I	0.05	3.3
Endosulfan II	0.10	3.3
Endosulfan Sulfate	0.10	3.3
Endrin	0.10	3.3
Endrin Aldehyde	0.10	3.3
Endrin Ketone	0.10	1.7
Heptachlor	0.05	1.7
Heptachlor Epoxide	0.05	1.7
Methoxychlor	0.50	17
Toxaphene	5	170
Aroclor - 1016	1	33
Aroclor - 1221	2	67



Table H. Continued.

Parameter	Aqueous (µg/L)	Solid (µg/Kg)
<b>Method 8081A - Pesticides/PCBs concluded</b>		
Aroclor - 1232	1	33
Aroclor - 1242	1	33
Aroclor - 1248	1	33
Aroclor - 1254	1	33
Aroclor - 1260	1	33
<b>Method 8151A - Herbicides</b>		
2,4,5-T	0.12	4.2
2,4,5,-TP (Silvex)	0.12	4.2
2,4-D	1.2	42
2,4-DB	1.2	42
Dalapon	3.1	100
Dicamba	0.12	4.2
Dichloroprop	1.2	42
Dinoseb	0.62	21
MCPA	0.12	4.2
MCPP	0.12	4.2
<b>Method 8260B - Volatiles, low-level</b>		
1,1,1,2-Tetrachloroethane	1.0	5.0
1,1,1-Trichloroethane	1.0	5.0
1,1,2,2-Tetrachloroethane	1.0	5.0
1,1,2-Trichloroethane	1.0	5.0
1,1-Dichloroethane	1.0	5.0
1,1-Dichloroethene	1.0	5.0
1,1-Dichloropropene	1.0	5.0
1,2,3-Trichlorobenzene	1.0	5.0
1,2,3-Trichloropropane	1.0	5.0
1,2,4-Trichlorobenzene	1.0	5.0
1,2,4-Trimethylbenzene	1.0	5.0
1,2,-Dibromo-3-chloropropane	1.0	5.0
1,2-Dibromoethane	1.0	5.0
1,2-Dichlorobenzene	1.0	5.0
1,2-Dichloroethane	1.0	5.0
cis-1,2-Dichloroethene	1.0	5.0
trans-1,2-Dichloroethene	1.0	5.0

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Table H. Continued.

Parameter	Aqueous (µg/L)	Solid (µg/Kg)
<i>Method 8260B - Volatiles, low-level continued</i>		
1,2-Dichloropropane	1.0	5.0
cis-1,2-Dichloropropene	1.0	5.0
trans-1,2-Dichloropropene	1.0	5.0
1,3,5-Trimethylbenzene	1.0	5.0
1,3-Dichlorobenzene	1.0	5.0
1,3-Dichloropropane	1.0	5.0
1,4-Dichlorobenzene	1.0	5.0
1-Chlorohexane	1.0	5.0
2,2-Dichloropropane	1.0	5.0
2-Butanone	5.0	10
2-Chlorotoluene	1.0	5.0
2-Hexanone	5.0	10
4-Chlorotoluene	1.0	5.0
4-Methyl-2-pentanone	5.0	10
Acetone	5.0	10
Benzene	1.0	5.0
Bromobenzene	1.0	5.0
Bromochloromethane	1.0	5.0
Bromodichloromethane	1.0	5.0
Bromoform	1.0	5.0
Bromomethane	2.0	5.0
n-Butylbenzene	1.0	5.0
sec-Butylbenzene	1.0	5.0
tert-Butylbenzene	1.0	5.0
Carbon Tetrachloride	1.0	5.0
Chlorobenzene	1.0	5.0
Chloroethane	2.0	5.0
Chloroform	1.0	5.0
Chloromethane	2.0	5.0
Dibromochloromethane	1.0	5.0
Dibromomethane	1.0	5.0
Dichlorodifluoromethane	2.0	5.0
Ethylbenzene	1.0	5.0
Hexachlorobutadiene	1.0	5.0
Isopropylbenzene	1.0	5.0

Table H. Continued.

Parameter	Aqueous (µg/L)	Solid (µg/Kg)
<b><i>Method 8260B - Volatiles, low-level concluded</i></b>		
<i>p</i> -Isopropyltoluene	1.0	5.0
Methylene Chloride	2.0	5.0
Naphthalene	1.0	5.0
<i>n</i> -Propylbenzene	1.0	5.0
Styrene	1.0	5.0
Tetrachloroethene	1.0	5.0
Toluene	1.0	5.0
Trichloroethene	1.0	5.0
Trichlorofluoromethane	1.0	5.0
Vinyl Chloride	1.0	5.0
Xylene (total)	1.0	5.0
<b><i>Method 8270C -Semi- Volatiles</i></b>		
1,2,4-Trichlorobenzene	10	330
1,2-Dichlorobenzene	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
2,2'-Oxybis (1-Chloropropane)	10	330
2,4,5-Trichlorophenol	25	830
2,4,6-Trichlorophenol	10	330
2,4-Dichlorophenol	10	330
2,4-Dimethylphenol	10	330
2,4-Dinitrophenol	25	830
2,4-Dinitrotoluene	10	330
2,6-Dinitrotoluene	10	330
<i>bis</i> -(2-Chloroethoxy)methane	10	330
<i>bis</i> -(2-Chloroethyl)ether	10	330
<i>bis</i> -(2-Chloroisopropyl)ether	10	330
2-Chloronaphthalene	10	330
2-Chlorophenol	10	330
<i>bis</i> -(2-Ethylhexyl)phthalate	10	330
2-Methylnaphthalene	10	330
2-Methylphenol	10	330
2-Nitroaniline	25	830
2-Nitrophenol	10	330
3,3'-Dichlorobenzadine	10	330

Table H. Continued.

Parameter	Aqueous (µg/L)	Solid (µg/Kg)
<i>Method 8270C -Semi- Volatiles continued</i>		
3-Nitroaniline	25	830
4,6-Dinitro-2-methylphenol	25	830
4-Bromophenyl-phenyl ether	10	330
4-Chloro-3-methylphenol	10	330
4-Chloroaniline	10	330
4-Chlorophenyl-phenyl ether	10	330
4-Methylphenol	10	330
4-Nitroaniline	25	830
4-Nitrophenol	25	830
Acenaphthene	10	330
Acenaphthylene	10	330
Anthracene	10	330
Benz(a)anthracene	10	330
Benzo(a)pyrene	10	330
Benzo(b)fluoranthene	10	330
Benzo(g,h,i)perylene	10	330
Benzo(k)fluoroanthene	10	330
Benzoic Acid	25	830
Benzyl Alcohol	25	830
Butylbenzylphthalate	10	330
Carbazole	10	330
Chrysene	10	330
Di-n-Butylphthalate	10	330
Di-n-Octylphthalate	10	330
Dibenzo(a,h)anthracene	10	330
Dibenzofuran	10	330
Diethylphthalate	10	330
Dimethylphthalate	10	330
Fluoranthene	10	330
Fluorene	10	330
Hexachlorobenzene	10	330
Hexachlorobutadiene	10	330
Hexachlorocyclopentadiene	10	330
Hexachloroethane	10	330
Indeno(1,2,3-c,d)pyrene	10	330

Table H. Concluded.

Parameter	Aqueous (µg/L)	Solid (µg/Kg)
<i>Method 8270C -Semi- Volatiles concluded</i>		
Isophorone	10	330
Naphthalene	10	330
Nitrobenzene	10	330
N-Nitrosodimethylamine	10	330
N-Nitrosodiphenylamine	10	330
N-Nitroso-di-n-propylamine	10	330
Pentachlorophenol	25	830
Phenanthrene	10	330
Phenol	10	330
Pyrene	10	330

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Table I. Routine Metals Reporting Limits

Element	Aqueous (mg/L)	Solid (mg/Kg)
<b>Method 6010B - ICP</b>		
Aluminum	0.1	10
Antimony	0.05	5
Arsenic	0.005	0.5
Barium	0.005	0.5
Beryllium	0.005	0.5
Cadmium	0.005	0.5
Calcium	1	100
Chromium	0.01	1
Cobalt	0.006	0.6
Copper	0.01	1
Iron	0.1	10
Lead	0.003	0.3
Magnesium	0.1	10
Manganese	0.003	0.3
Nickel	0.01	1
Potassium	0.5	50
Selenium	0.005	0.5
Silver	0.01	1
Sodium	1	100
Thallium	0.005	0.5
Vanadium	0.01	1
Zinc	0.01	1
<b>Method 7000 Series - GFAA</b>		
Antimony	0.005	0.5
Arsenic	0.005	0.5
Cadmium	0.001	0.1
Chromium	0.005	0.5
Lead	0.005	0.5
Mercury	0.0002	0.1
Selenium	0.005	0.5
Thallium	0.001	0.1

Table J. Routine General Chemistry Reporting Limits

Parameter	Method <sup>1</sup>	Aqueous (mg/L) <sup>2</sup>	Solid (mg/Kg)
Acidity	E 305.2	0.1 meq	N/A
Alkalinity	E 310.1	4	N/A
Ammonia	E 350.3	0.1	N/A
Chemical Oxygen Demand	E 410.2	20	N/A
Chloride	E 325.3; S 9252A	2	N/A
Conductivity	E 120.1; S 9050	1 umho/cm	N/A
Cyanide	E 335.2; S 9010A	0.010	0.5
Fluoride	E 340.2	0.1	N/A
Hardness	E 130.2	2	N/A
Nitrate	E 325.1; S 9200	0.1	N/A
(Total) Phenolics	E 420.1	0.05	N/A
Phosphorus (total & <i>ortho</i> )	E 365.2	0.01	N/A
Reactive Cyanide	S 7.3	0.5	0.5
Reactive Sulfide	S 7.3	2.5	2.5
Sulfate	E 375.4	5	N/A
Total Dissolved Solids (Residue, dissolved)	E 160.1	10	N/A
Total Organic Carbon	E 415.1	2	N/A
Total Solids (Residue)	E 160.3	10	N/A
Total Suspended Solids (Residue, suspended)	E 160.2	10	N/A
Volatile Suspended Solids (Residue, volatile (suspended))	E 160.4	10	N/A

<sup>1</sup> Prefix E: USEPS 600 methodologies; Prefix S: USEPS SW-846 methodologies

<sup>2</sup> Unless stated otherwise

**Figure K. PDP Review Process**

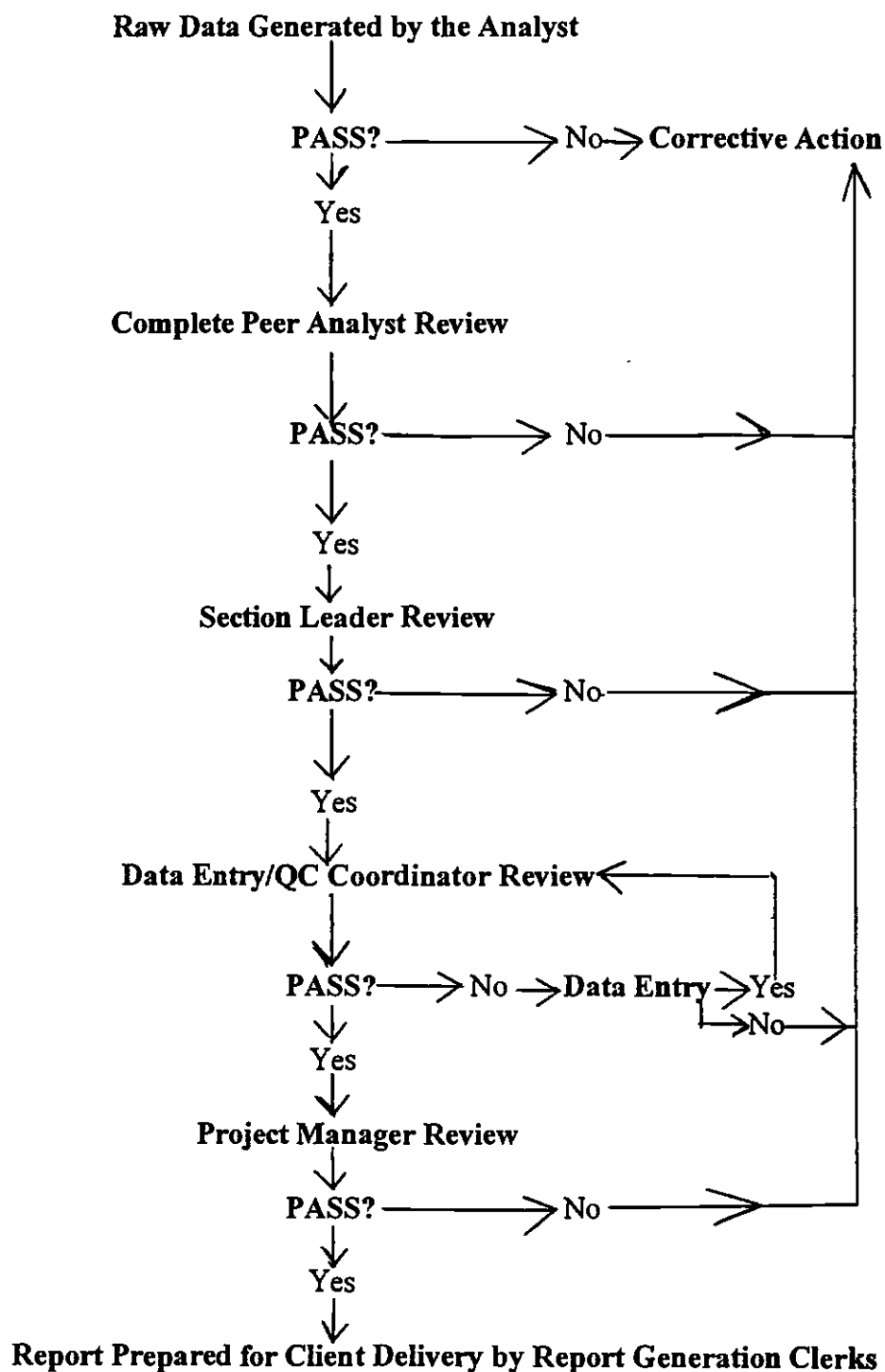




Table L. Required Quality Control Samples and Frequency

Analytical Method	Parameter	QC Check Samples	Frequency (per matrix)	Acceptable Criteria	Corrective Actions
<i>Organics</i>					
418.1	Total Petroleum Hydrocarbons (TPH)	Method Blank LCS Instrument Blank MS	1/20 1/20 1/10 1/20	< RL <i>See Table M.</i> <i>See Table M.</i> <i>See Table M.</i>	Re-analyze Case Narrative Re-analyze Case Narrative
8015B Extractables	TPH - Diesel	Method Blank LCS Surrogate MS	1/20 1/20 1 per sample 1 pr./20	< RL <i>See Table M.</i> <i>See Table M.</i> <i>See Table M.</i>	Re-analyze Case Narrative Re-analyze Case Narrative
8015B Volatiles	TPH - Gasoline	Method Blank LCS Surrogate MS	1/20 1/20 1 per sample 1 pr./20	< RL <i>See Table M.</i> <i>See Table M.</i> <i>See Table M.</i>	Re-analyze Case Narrative Re-analyze Case Narrative
8021B	BTEX (Aromatics)	Method Blank LCS Surrogate MS	1/20 1/20 1 per sample 1 pr./20	< RL <i>See Table M.</i> <i>See Table M.</i> <i>See Table M.</i>	Re-analyze Case Narrative Re-analyze Case Narrative
8081A	Pesticides	Method Blank LCS Surrogate MS	1/20 1/20 2 per sample 1 pr./20	< RL <i>See Table M.</i> <i>See Table M.</i> <i>See Table M.</i>	Re-analyze Case Narrative Re-analyze (if both out) Case Narrative
8151A	Herbicides	Method Blank LCS Surrogate MS	1/20 1/20 1 per sample 1 pr./20	< RL <i>See Table M.</i> <i>See Table M.</i> <i>See Table M.</i>	Re-analyze Case Narrative Re-analyze Case Narrative
8260B	Volatiles; low-level	Method Blank LCS Surrogate MS	1/20 1/20 4 per sample 1 pr./20	< RL <i>See Table M.</i> <i>See Table M.</i> <i>See Table M.</i>	Re-analyze Case Narrative Re-analyze Case Narrative
8270C	Semi-Volatiles	Method Blank LCS Surrogate MS	1/20 1/20 6 per sample 1 pr./20	< RL <i>See Table M.</i> <i>See Table M.</i> <i>See Table M.</i>	Re-analyze Case Narrative Re-analyze Case Narrative

Table L. Continued.

Analytical Method	Parameter	QC Check Samples	Frequency (per matrix)	Acceptable Criteria	Corrective Actions
Metals					
6010B	ICP Metals	Method Blank	1/20	< RL	Re-analyze with affected samples
		LCS	1/20	See Table N.	Re-prep and Re-analyze
		MS	1 pr./20	See Table N.	Case Narrative
7000 Series	GFAA Metals	Method Blank	1/20	< RL	Re-analyze
		LCS	1/20	See Table N.	Re-analyze
		Sample Duplicate	1/20	See Table N.	Re-analyze
		MS	1 pr./20	See Table N.	Run Bench Spike
7470A 7471A	Mercury	Method Blank	1/20	< RL	Re-analyze with affected samples
		LCS	1/20	See Table N.	Re-prep and Re-analyze
		MS	1 pr./20	See Table N.	Case Narrative
TCLP					
1311	TCLP (all methods)	Extraction Blank	1/matrix/ batch	< RL	Re-extract; re-analyze with affected samples
		MS	1/matrix	See Tables M & N.	Case Narrative
General Chemistry					
1010	Ignitability (Flashpoint)	Method Blank	1/20	< 200°F	Re-analyze
		LCS	2/20	See Table O.	Re-analyze
		Sample Duplicate	1/20	See Table O.	Case Narrative
9010B 335.2	Cyanide (Reactive)	Method Blank	1/20	< RL	Re-analyze
		LCS	2/20	See Table O.	Re-analyze
		MS	1 pr./20	See Table O.	Case Narrative
9030B 376.1	Sulfide (Reactive)	Method Blank	1/20	< RL	Re-analyze
		LCS	2/20	See Table O.	Re-analyze
		MS	1 pr./20	See Table O.	Case Narrative
9038 375.4	Sulfate	Method Blank	1/20	< RL	Re-analyze
		LCS	2/20	See Table O.	Re-analyze
		MS	1 pr./20	See Table O.	Case Narrative

Table L. Continued.

Analytical Method	Parameter	QC Check Samples	Frequency (per matrix)	Acceptable Criteria	Corrective Actions
<i>General Chemistry continued</i>					
9041A 150.1	Corrosivity (pH) - aqueous	LCS Sample Duplicate	2/20 1/20	See Table O. See Table O.	Re-analyze Case Narrative
9045C	Corrosivity (pH) - solid	LCS Sample Duplicate	2/20 1/20	See Table O. See Table O.	Re-analyze Case Narrative
9050A	Conductivity	Method Blank Sample Duplicate	1/20 1/20	< RL See Table O.	Re-analyze Case Narrative
9060 415.1	Total Organic Carbon (TOC)	Method Blank LCS MS	1/20 2/20 1 pr./20	< RL See Table O. See Table O.	Re-analyze Re-analyze Case Narrative
9065 420.1	Total Phenolics	Method Blank LCS MS	1/20 2/20 1 pr./20	< RL See Table O. See Table O.	Re-analyze Re-analyze Case Narrative
9200 352.1	Nitrate as Nitrogen	Method Blank LCS MS	1/20 2/20 1 pr./20	< RL See Table O. See Table O.	Re-analyze Re-analyze Case Narrative
9252A 325.3	Chloride	Method Blank LCS MS	1/20 2/20 1 pr./20	< RL See Table O. See Table O.	Re-analyze Re-analyze Case Narrative
130.2	Hardness	Method Blank LCS Sample Duplicate	1/20 2/20 1/20	< RL See Table O. See Table O.	Re-analyze Re-analyze Case Narrative
160.1	Total Dissolved Solids (TDS)	Method Blank LCS Sample Duplicate	1/20 2/20 1/20	< RL See Table O. See Table O.	Re-analyze Re-analyze Case Narrative
160.2	Total Suspended Solids (TSS)	Method Blank LCS Sample Duplicate	1/20 2/20 1/20	< RL See Table O. See Table O.	Re-analyze Re-analyze Case Narrative
310.1	Alkalinity	LCS Sample Duplicate	2/20 1/20	See Table O. See Table O.	Re-analyze Case Narrative

Table L. Concluded.

Analytical Method	Parameter	QC Check Samples	Frequency (per matrix)	Acceptable Criteria	Corrective Actions
<b><i>General Chemistry concluded</i></b>					
340.2	Fluoride	LCS MS	2/20 1 pr./20	See Table O. See Table O.	Re-analyze Case Narrative
350.3	Ammonia as Nitrogen	LCS MS	2/20 1 pr./20	See Table O. See Table O.	Re-analyze Case Narrative
354.1	Nitrite as Nitrogen	Method Blank LCS MS	1/20 2/20 1 pr./20	< RL See Table O. See Table O.	Re-analyze re-analyze Case Narrative
365.2	Phosphorus (total and ortho-)	Method Blank LCS MS	1/20 2/20 1 pr./20	< RL See Table O. See Table O.	Re-analyze re-analyze Case Narrative
410.4	Chemical Oxygen Demand (COD)	Method Blank LCS MS	1/20 2/20 1 pr./20	< RL See Table O. See Table O.	Re-analyze re-analyze Case Narrative

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Table M. Acceptance Criteria for Organic Quality Control Parameters

Spike Compound	Spike Concentration		Percent Recovery		Reported Percent Difference (%RPD)	
	Aqueous (µg/L)	Solid (µg/L)	Aqueous (%)	Solid (%)	Aqueous (%)	Solid (%)
<b>Method 418.1 - TPH</b>						
TPH neat solution	5	250	50-150	50-150	30	30
<b>Method 8015B - TPH Diesel (Extraction)</b>						
Diesel Standard	1000	33000	50-150	50-150	50	50
<i>o</i> -terphenyl (surr.)	200	6600	50-150	50-150	N/A	N/A
<b>Method 8015B - TPH Gasolines (Volatiles)</b>						
Gasoline Standard	750	750	75-125	70-130	25	25
<i>a,a,a</i> -trifluorotoluene (surr.)	50	50	75-125	70-130	N/A	N/A
<b>Method 8021B - BTEX</b>						
Benzene	50	50	75-125	70-130	25	30
Toluene	50	50	75-125	70-130	25	30
Ethylbenzene	50	50	75-125	70-130	25	30
Xylenes	50	50	75-125	70-130	25	30
<i>a,a,a</i> -trifluorotoluene (surr.)	50	50	75-125	70-130	N/A	N/A
<b>Method 8081A - Pesticides/PCBs</b>						
4,4-DDT	1.0	33.3	38-127	23-134	≤ 27	≤ 50
Aldrin	0.5	16.7	40-120	34-132	≤ 22	≤ 43
Dieldrin	1.0	33.3	52-126	31-134	≤ 18	≤ 38
Endrin	1.0	33.3	56-121	42-139	≤ 21	≤ 45
<i>gamma</i> -BHC (Lindane)	0.5	16.7	56-123	46-127	≤ 15	≤ 50
Heptachlor	0.5	16.7	40-131	35-130	≤ 20	≤ 31
Tetrachloro- <i>m</i> -xylene (surr.)	6.7	6.7	30-150	30-150	N/A	N/A
Decachlorobiphenyl (surr.)	6.7	6.7	30-150	30-150	N/A	N/A
<b>Method 8151A - Herbicides</b>						
2,4,5-T	1.25	8.4	30-150	30-150	≤ 50	≤ 50
2,4,5-TP (Silvex)	1.25	8.4	30-150	30-150	≤ 50	≤ 50

Table M. Continued.

Spike Compound	Spike Concentration		Percent Recovery		Reported Percent Difference (%RPD)	
	Aqueous (µg/L)	Solid (µg/L)	Aqueous (%)	Solid (%)	Aqueous (%)	Solid (%)
<b>Method 8151A - Herbicides concluded</b>						
2,4-D	12.5	83.5	30-150	30-150	≤ 50	≤ 50
2,4-DB	12.5	83.5	30-150	30-150	≤ 50	≤ 50
Dicamba	1.25	8.4	30-150	30-150	≤ 50	≤ 50
Dichloroprop	12.5	83.5	30-150	30-150	≤ 50	≤ 50
Dinoseb	6.25	41.7	30-150	30-150	≤ 50	≤ 50
MCPA	12.5	209.0	30-150	30-150	≤ 50	≤ 50
MCP	12.5	835.0	30-150	30-150	≤ 50	≤ 50
2,4-Dichlorophenyl-acetic Acid (surr.)	0.5	16.7	30-150	30-150	N/A	N/A
<b>Method 8260B - Volatiles, low-level</b>						
1,1-Dichloroethene	10	10	61-145	59-172	14	22
Benzene	10	10	76-127	62-137	11	24
Chlorobenzene	10	10	75-130	66-142	13	21
Toluene	10	10	76-125	59-139	13	21
Trichloroethene	10	10	71-120	60-133	14	21
Dibromofluoromethane (surr.)	50	50	86-118	74-121	N/A	N/A
Toluene-d8 (surr.)	50	50	88-110	80-120	N/A	N/A
4-Bromofluorobenzene (surr.)	50	50	86-115	81-117	N/A	N/A
Dichloroethane-d4 (surr.)	50	50	80-120	80-120	N/A	N/A
<b>Method 8270C - Semi-Volatiles</b>						
1,2,4-Trichlorobenzene	50	1667	39-98	38-107	≤ 42	≤ 35
1,4-Dichlorobenzene	50	1667	36-97	28-104	≤ 40	≤ 50
2,4-Dinitrotoluene	50	1667	24-96	28-89	≤ 28	≤ 27
2-Chlorophenol	75	2500	27-123	25-102	≤ 38	≤ 38
4-Chloromethylphenol	75	2500	23-97	26-103	≤ 28	≤ 23
4-Nitrophenol	75	2500	10-80	11-114	≤ 42	≤ 33
Acenaphthene	50	1667	46-118	31-137	≤ 31	≤ 19

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Table M. Concluded.

Spike Compound	Spike Concentration		Percent Recovery		Reported Percent Difference (%RPD)	
	Aqueous (µg/L)	Solid (µg/L)	Aqueous (%)	Solid (%)	Aqueous (%)	Solid (%)
<i>Method 8270C - Semi-Volatiles concluded</i>						
<i>N</i> -Nitroso-di- <i>n</i> -propylamine	50	1667	41-116	41-126	≤ 50	≤ 50
Pentachlorophenol	75	2500	9-103	17-109	≤ 38	≤ 47
Phenol	75	2500	12-110	26-190	≤ 50	≤ 47
Pyrene	50	1667	26-127	35-142	≤ 31	≤ 36
Nitrobenzene- <i>d</i> 5 (surr.)	50	1667	35-114	23-120	<i>N/A</i>	<i>N/A</i>
2-Fluorobiphenyl (surr.)	50	1667	43-116	20-115	<i>N/A</i>	<i>N/A</i>
Terphenyl- <i>d</i> 14 (surr.)	50	1667	33-141	18-137	<i>N/A</i>	<i>N/A</i>
Phenol- <i>d</i> 6 (surr.)	75	2500	10-94	24-113	<i>N/A</i>	<i>N/A</i>
2-Fluorophenol	75	2500	21-100	25-121	<i>N/A</i>	<i>N/A</i>
2,4,6-Tribromophenol (surr.)	75	2500	10-123	19-122	<i>N/A</i>	<i>N/A</i>

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Table N. Continued.

Spike Compound	Spike Concentration		Percent Recovery		Reported Percent Difference (%RPD)	
	Aqueous (mg/L)	Solid (mg/L)	Aqueous (%)	Solid (%)	Aqueous (%)	Solid (%)
<i>Method 6010B - ICP Metals (CLP) concluded</i>						
Copper	0.25	25	75-125	75-125	≤ 20	≤ 20
Iron	1.0	100	75-125	75-125	≤ 20	≤ 20
Lead	0.5	50	75-125	75-125	≤ 20	≤ 20
Manganese	0.5	50	75-125	75-125	≤ 20	≤ 20
Nickel	0.5	50	75-125	75-125	≤ 20	≤ 20
Selenium	2.0	200	75-125	75-125	≤ 20	≤ 20
Silver	0.05	5.0	75-125	75-125	≤ 20	≤ 20
Thallium	2.0	200	75-125	75-125	≤ 20	≤ 20
Vanadium	0.5	50	75-125	75-125	≤ 20	≤ 20
Zinc	0.5	50	75-125	75-125	≤ 20	≤ 20
<i>TCLP (SW-846)</i>						
Arsenic	0.05	0.05	75-125	75-125	N/A	N/A
Barium	10	10	75-125	75-125	N/A	N/A
Cadmium	2.5	2.5	75-125	75-125	N/A	N/A
Chromium	1.0	1.0	75-125	75-125	N/A	N/A
Lead	0.05	0.05	75-125	75-125	N/A	N/A
Selenium	0.05	0.05	75-125	75-125	N/A	N/A
Silver	1.25	1.25	75-125	75-125	N/A	N/A
<i>TCLP (CLP)</i>						
Arsenic	5.0	5.0	75-125	75-125	N/A	N/A
Barium	10	10	75-125	75-125	N/A	N/A
Cadmium	1.0	1.0	75-125	75-125	N/A	N/A
Chromium	5.0	5.0	75-125	75-125	N/A	N/A
Lead	5.0	5.0	75-125	75-125	N/A	N/A
Selenium	1.0	1.0	75-125	75-125	N/A	N/A
Silver	5.0	5.0	75-125	75-125	N/A	N/A
<i>Methods 7470A/7471A - Mercury; aqueous/solid (SW-846)</i>						
Mercury	0.0020	1.0	80-120	80-120	N/A	N/A



Table N. Concluded.

Spike Compound	Spike Concentration		Percent Recovery		Reported Percent Difference (%RPD)	
	Aqueous (mg/L)	Solid (mg/L)	Aqueous (%)	Solid (%)	Aqueous (%)	Solid (%)
<i>Methods 7470A/7471A - Mercury; aqueous/solid (CLP)</i>						
Mercury	0.001	0.5	75-125	75-125	N/A	N/A
<i>Method 7000 Series - GFAA Metals (SW-846)</i>						
Antimony	0.1	10	80-120	80-120	≤ 20	≤ 20
Arsenic	0.05	5.0	80-120	80-120	≤ 20	≤ 20
Cadmium	0.005	0.5	80-120	80-120	≤ 20	≤ 20
Chromium	0.05	5.0	80-120	80-120	≤ 20	≤ 20
Copper	0.05	5.0	80-120	80-120	≤ 20	≤ 20
Lead	0.05	5.0	80-120	80-120	≤ 20	≤ 20
<i>Method 7000 Series - GFAA Metals (SW-846) concluded</i>						
Selenium	0.05	5.0	80-120	80-120	≤ 20	≤ 20
Silver	0.005	0.5	80-120	80-120	≤ 20	≤ 20
Thallium	0.05	5.0	80-120	80-120	≤ 20	≤ 20
<i>Method 7000 Series - GFAA Metals (CLP)</i>						
Antimony	0.1	10	75-125	75-125	≤ 20	≤ 20
Arsenic	0.04	4.0	75-125	75-125	≤ 20	≤ 20
Cadmium	0.005	0.5	75-125	75-125	≤ 20	≤ 20
Chromium	0.05	5.0	75-125	75-125	≤ 20	≤ 20
Copper	0.05	5.0	75-125	75-125	≤ 20	≤ 20
Lead	0.02	2.0	75-125	75-125	≤ 20	≤ 20
Selenium	0.01	1.0	75-125	75-125	≤ 20	≤ 20
Silver	0.005	0.5	75-125	75-125	≤ 20	≤ 20
Thallium	0.05	5.0	75-125	75-125	≤ 20	≤ 20

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Table O. Acceptance Criteria for General Chemistry Quality Control Parameters

Compound	Spike Concentration		Percent Recovery		Reported Percent Difference (%RPD)	
	Aqueous (mg/L)	Solid (mg/L)	Aqueous (%)	Solid (%)	Aqueous (%)	Solid (%)
<b>Method 1010 - Ignitability</b>						
Carbon	N/A	N/A	N/A	N/A	≤ 20	N/A
<b>Methods 9010B; 335.2 - Cyanide</b>						
Total Cyanide	0.1	5	75-125	75-125	≤ 20	≤ 20
Reactive Cyanide	10	10	75-125	75-125	≤ 20	≤ 20
<b>Methods 9038B; 375.4 - Sulfate</b>						
Sulfate	20	N/A	75-125	N/A	≤ 20	N/A
<b>Methods 9040B; 9045C; 150.1 - Corrosivity (pH)</b>						
N/A	N/A	N/A	N/A	N/A	≤ 20	≤ 20
<b>Method 9050A - Conductance</b>						
N/A	N/A	N/A	N/A	N/A	≤ 20	≤ 20
<b>Methods 9060; 415.1 - Total Organic Carbon (TOC)</b>						
TOC	25	N/A	75-125	N/A	≤ 20	N/A
<b>Methods 9065; 420.1 - Total Phenolics</b>						
Phenol	0.5	N/A	75-125	N/A	≤ 20	N/A
<b>Methods 9200; 352.1 - Nitrate as Nitrogen</b>						
Nitrogen	0.4	N/A	75-125	N/A	≤ 20	N/A
<b>Methods 9252A; 325.3 - Chloride</b>						
Chloride	200	N/A	75-125	N/A	≤ 20	N/A
<b>Method 130.2 - Hardness</b>						
Calcium	N/A	N/A	N/A	N/A	≤ 20	N/A
<b>Method 160.1 - Total Dissolved Solids (TDS)</b>						
Residue	N/A	N/A	N/A	N/A	≤ 20	N/A
<b>Method 160.2 - Total Suspended Solids (TSS)</b>						
Residue	N/A	N/A	N/A	N/A	≤ 20	N/A
<b>Method 310.1 - Alkalinity</b>						
N/A	N/A	N/A	N/A	N/A	≤ 20	N/A
<b>Method 340.2 - Fluoride</b>						
Fluoride	5	N/A	75-125	N/A	≤ 20	N/A

Table O. Concluded.

Compound	Spike Concentration		Percent Recovery		Reported Percent Difference (%RPD)	
	Aqueous (mg/L)	Solid (mg/L)	Aqueous (%)	Solid (%)	Aqueous (%)	Solid (%)
<i>Method 350.3 - Ammonia as Nitrogen</i>						
Nitrogen	5	N/A	75-125	N/A	≤ 20	N/A
<i>Method 354.1 - Nitrite as Nitrogen</i>						
Nitrogen	0.5	N/A	75-125	N/A	≤ 20	N/A
<i>Method 365.2 - Phosphorus (Total and ortho-)</i>						
Phosphorus	0.5	N/A	75-125	N/A	≤ 20	N/A
<i>Method 410.4 - Carbon-Oxygen Demand (COD)</i>						
Carbon-Oxygen	75	N/A	75-125	N/A	≤ 20	N/A

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**Table P. Water Pollution Study Parameters**

Trace Metals
Minerals
Nutrients
Pesticides/PCBs
Volatile Halocarbons
Volatile Aromatics
Miscellaneous General/Wet Chemistry

**Table Q. Water Supply Study Parameters**

Trace Metals
Minerals
Nutrients
Miscellaneous General/Wet Chemistry

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Table R. Preventative Maintenance and Performance Frequency

Instrument	Maintenance	Frequency
Gas Chromatograph / Mass Spectrometer (GC/MS)	Vacuum Pump Oil Change	Biannually
	Source Cleaned	As Needed
	Filament Replaced	As Needed
	Air Filters Changed	Biannually
	Change Septa	As Needed (minimum - daily)
	Change/Clean Injection Port Liners	As Needed (minimum - daily)
	Replace Columns	As Needed
	Replace Traps	As Needed
Gas Chromatographs (GC)	Change Septa	As Needed (minimum - weekly)
	Change/Clean Injection Port Liners	As Needed
	Change Autosampler Waste Vials	Weekly
	Check Syringe Operation	Weekly
	Replace Columns	As Needed
	Replace Traps	As Needed
	NRC Wipe Test (ECD)	Biannually
	Clean FID jet	As Needed
	Clean/Change PID Lamp	As Needed
Mercury Analyzer	Replace Mercury Lamp	As Needed
	Replace Cell Window	As Needed
Graphite Furnace (GFAA)	Clean Contact Cylinders	As Needed
	Replace Graphite Tube	As Needed
	Clean Furnace Head	Daily
	Clean Furnace Windows	Daily
	Replace Contact Cylinders	As Needed
	Clean Autosampler Pump Valves	Monthly
	Replaced damaged gas hoses	As Needed
Inductively Coupled Plasma Spectrometer (ICP)	Replace Pump Tubing	As Needed
	Clean Nebulizer	As Needed
	Clean Spray Chamber	As Needed
	Replace Torch Coupling O-Rings	As Needed
	Clean Vacuum Filters	Weekly
	Make New Triton-X Solution	Biweekly

Table R. Concluded.

Instrument	Maintenance	Frequency
Spectrophotometers	Replace Lamps and Align	As Needed
	Clean Sample Compartment Side of Field Lens	As Needed
Total Organic Carbon Analyzer	Fill Reagent Reservoirs	As Needed
	Adjust Injection Pump Flow	As Needed
	Adjust IR to Zero	Weekly
Analytical Balances	Cleaning and Calibration Check	Daily
	Contracted Servicing	Annually
Conductivity Meter	Cleaning and Calibration Check	Weekly
pH/Specific Ion Meters	Change Ionic Solution	As Needed
Hoods	Velocity Check	Quarterly
	Contracted Service	Annually
Ovens/Refrigerators	Clean Interiors	As Needed

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**Figure S. Standard Operation Procedure Format (SOPs)**

The following outline may be altered to better fit the scope of material. Assignment numbers are to ensure a generally ordered flow for reference. However, the alteration may slightly change the sub-numbers. Major sections should not be removed; rather, notate that they are not applicable to the subject matter.

Title (includes method number)

1. Scope and Application
  - 1.1. Analytes
  - 1.2. Quantitation Limits
  - 1.3. Applicable Matrices
  - 1.4. Dynamic Range
  - 1.5. Approximate Analytical Time
2. Summary of Method
  - 2.1. Generic Description of Method and Supporting Chemistry
3. Comments
  - 3.1. Interferences
  - 3.2. Helpful Hints
4. Safety Issues or Cautions for this Method
5. Sample Collection, Preservation, Containers, and Holding Times
6. Apparatus and Materials
7. Reagents and Standards
8. Detailed Procedure
9. QA/QC Requirements
  - 9.1. QC Samples and Limits (precision and acceptance limits)
10. Corrective Actions
  - 10.1. Describe Actions Needed (exceeded QC limits and/or other anomalies)
11. Calculations
12. Reporting
  - 12.1. Reporting Units
  - 12.2. Reporting Limits
  - 12.3. Significant Figures and Reporting Values Below the Detection Limit
13. References
14. Method Deviations

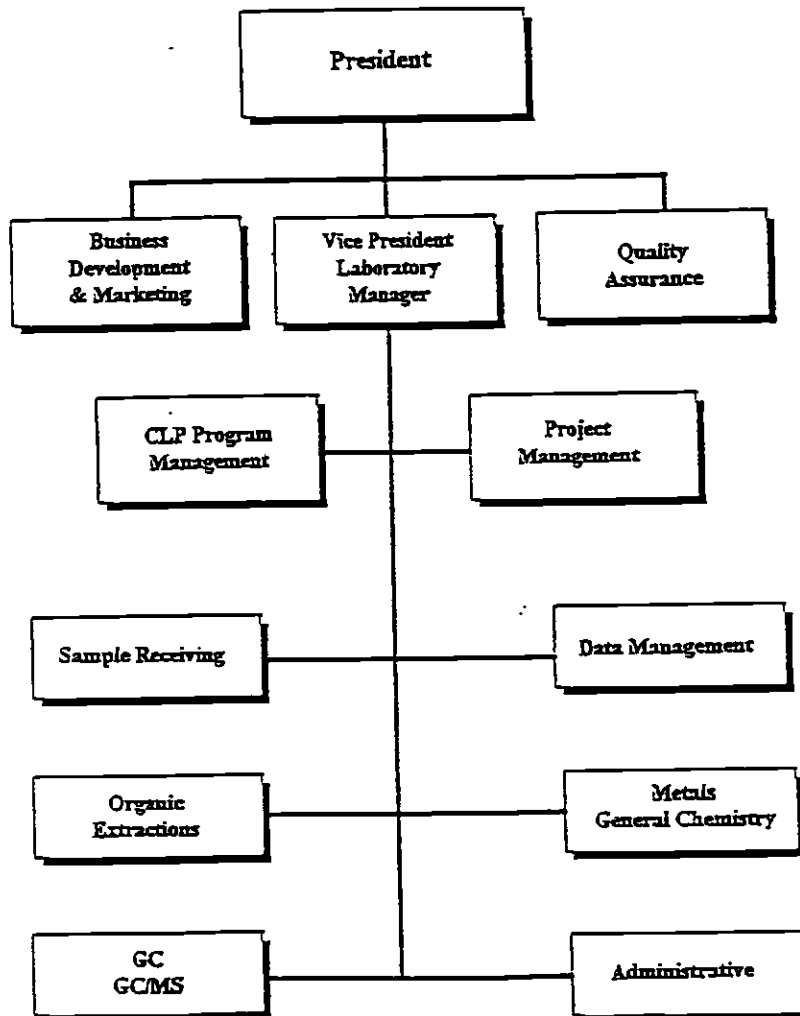
Figure T. Quality Assurance Report Format

The following outline may be altered to better fit the scope of material. Assignment numbers are to ensure a generally ordered flow for reference. However, the alteration may slightly change the sub-numbers. Major sections should not be removed; rather, notate that they are not applicable to this monthly report.

1. Quality Assurance and Control
  - 1.1. Resolutions to QA/QC Problems  
Description of resolutions to problems from the current or previous months
  - 1.2. QA/QC Problems  
New QA/QC problems
  - 1.3. QA/QC Improvement Suggestions  
Description of changes in documentation, protocol, general practice, *etc.* which may improve/correct QA/QC problems or the QA program
  - 1.4. Certifications  
Any changes, renewals, *etc.*
  - 1.5. Training  
Listing of all documented training occurrences
  - 1.6. Controlled Documents  
Distribution and review status
2. QA Assessments
  - 2.1. Internal Audits and Inspections
  - 2.2. Performance Evaluations  
Results, responses, determination of need
  - 2.3. Control Charts
  - 2.4. Data and Process Rejections  
Corrective Actions, data review, holding times, *etc.*
3. Safety
  - 2.1. Safety Activities, Training, and Improvements
  - 2.2. Safety Assessments
4. Planned Projects



Figure U. Organizational Chart



**ATTACHEMENT II****SELECT QUALITY ASSURANCE FORMS**  
**used by**  
**PDP ANALYTICAL SERVICES**

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Attachment II

Figure A. Group Training Log

PDP ANALYTICAL SERVICES  
1680 Lake Front Circle, Suite B, The Woodlands, TX 77380

TRAINING ATTENDANCE SHEET

Training Performed By: \_\_\_\_\_ Date: \_\_\_\_\_

Topic Description: \_\_\_\_\_

In Attendance:	(Print Name)	(Signature)
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____

SIG. OF INSTRUCTOR/SUPERVISOR: \_\_\_\_\_ DATE: \_\_\_\_\_

Z:\NETDATA\QA\FORMS\LABRATAS\408

Figure B. Individual Training Log

PDP ANALYTICAL SERVICES  
1680 Lake Front Circle, Suite B, The Woodlands, TX 77380

### TRAINING RECORD SHEET

EMPLOYEE NAME: \_\_\_\_\_

TESTS/METHODS: \_\_\_\_\_

PDP SOP NO.: \_\_\_\_\_

I have read and understood the S.O.P.s: \_\_\_\_\_  
Signature/Date

**TRAINING DETAILS:**

DATE	EPISODE/ SAMPLE IDs	TRAINING DESCRIPTION	SIG. OF INSTRUCTOR	SIG. OF EMPLOYEE
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

**TRAINING COMMENTS TO BE COMPLETED BY SUPERVISOR OR INSTRUCTOR.**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SIGNATURE OF EMPLOYEE: \_\_\_\_\_ DATE: \_\_\_\_\_

SIG. OF INSTRUCTOR/SUPERVISOR: \_\_\_\_\_ DATE: \_\_\_\_\_

**PDP Analytical Services**  
**1680 Lake Front Circle, Suite B**  
**The Woodlands, TX 77380**

**Effective: June 30, 1999**

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**Figure D. Sample Receipt and Log-in Checklist (SRLC)**

COMMENTS:

**Effective: June 30, 1999**

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## Attachment II

**Figure E. Internal/Refrigerator Chain-of-Custody**

RCS NO. 451-SCL-0297

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### SAMPLE CUSTODY LOG

## WALK-IN COOLER

[illegible]

Container type: 40ml, 2WM, 4WM, 8WM, 16WM, 32WM, 1L Amber, 80 Amber, 1L Poly, 16 Poly, Other.

**Note:** Each sample container must be signed out & in by the Sample Custodian or designated personnel. If the designated personnel relinquish the sample containers, then the Sample Custodian must confirm the actions taken and sign in the applicable verification columns.

Empty containers must be returned to the SAMPLE CUSTODIAN and documented in the "signed in by" column with an "E".

Z:\NETDATA\OAV\FORMS\CLIST0696.DOC

PAGE

Figure F. Disposal Logbook Sample Page

RCS NO. 407-SDL-0996

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## SAMPLE DISPOSAL LOGBOOK

[illegible]

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COMMENTS \_\_\_\_\_

PAGE \_\_\_\_\_



Figure G. Data Review and Case Narrative Form

DATA REVIEW CHECKLIST AND CASE NARRATIVE

EPISODE: \_\_\_\_\_

PAGE 1 OF 2

PARAMETERS: \_\_\_\_\_

DATA REPORT CHECKLIST: Please check off those which are included in the data package.

_____ LOG-IN SHEETS	_____ TOTAL PREP/EXTRACTION LOG SHEETS
_____ CORRECTIVE ACTION REPORTS	_____ % MOISTURE LOG SHEETS
_____ QC BATCH SUMMARY	_____ RUN LOG SHEETS
_____ TCLP PREP LOG SHEETS	_____ RAW DATA (CALIBRATION, SX, QC)

DATA ENTRY/REVIEW:

I certify that all data generated are in accordance with required methodologies and/or standard operating procedures except for the conditions detailed on this page.

Analyst \_\_\_\_\_ Date \_\_\_\_\_

DATA ENTRY PERFORMED BY: \_\_\_\_\_ (signature) \_\_\_\_\_ (date)

TECHNICAL REVIEW BY: \_\_\_\_\_

DATA REVIEW OFFICER: \_\_\_\_\_

QC CRITERIA COMPLIANCE: Please assess the QC criteria for all initial and re-extraction/re-analysis batches. Answer "Y" if all criteria were met and "N" if any out-of-control events occurred. A Corrective Action Report must be completed for all out-of-control events and included with this package.

_____ HOLDING TIMES	_____ LABORATORY CONTROL SAMPLES
_____ INITIAL CALIBRATIONS	_____ ANALYTICAL AND MATRIX SPOKES
_____ CONTINUING CALs	_____ DUPLICATES
_____ INTERFERENCE CHECK STDs	_____ SURROGATES
_____ TUNES (BFB, DFTPP)	_____ INTERNAL STANDARDS
_____ SYSTEM AND METHOD BLANKS	

ANALYST NOTES: Please describe in detail all dilutions, re-extractions/re-analyses, out-of-control events, deviations from the methods, if any, etc.

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Figure G. Concluded.

DATA REVIEW CHECKLIST AND CASE NARRATIVE (continued)

PAGE 2 OF 2

CASE NARRATIVE: *Supervisor, please describe in detail below that information to be reported to the client.*

Z:\NET\DATA\QA\FORMS\DRCC\7194.DOC

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Figure H. Final Report Review Checklist

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FINAL REPORT REVIEW CHECKLIST

Episode No: \_\_\_\_\_ Client: \_\_\_\_\_

Y	N	NA	Is Chain-of-Custody signed, dated and time recorded by individual receiving samples?
Y	N	NA	Does Log-in sheet agree with COC?
Y	N	NA	Does Report agree with Log-in sheet?
Y	N	NA	Client ID's vs PDP ID's?
Y	N	NA	Parameters performed that were requested?
Y	N	NA	Holding Times met?
Y	N	NA	TAT met?
Y	N	NA	Special instructions noted?
Y	N	NA	Has raw data been transcribed correctly to report?
Y	N	NA	Are significant figures correct?
Y	N	NA	Are all method blanks included and acceptable?
Y	N	NA	Are all duplicate results included and acceptable?
Y	N	NA	Are all matrix spikes included and acceptable?
Y	N	NA	Are all matrix spike duplicates included and acceptable?
Y	N	NA	Are all analysis dates correct?
Y	N	NA	Are all observations present in Case Narrative?
Y	N	NA	Is report in correct order?
Y	N	NA	Is raw data requested and included?
Y	N	NA	Is cover letter present?

Final Report Approved: \_\_\_\_\_ Date: \_\_\_\_\_

**BEST AVAILABLE  
COPY**11  
Attachment II

Figure I. Corrective Action Report (CAR)

**CORRECTIVE ACTION REPORT**

**INSTRUCTIONS:** For all out-of-control events encountered during sample preparation and/or analysis, a Corrective Action Report must be generated. Please investigate each event, determine the probable cause, ascertain and implement the corrective actions to bring the affected systems back into control, and indicate how such event(s) may be avoided in the future. All out-of-control events must be reported to the QA Manager immediately. The completed original must be submitted in the applicable data package, inserted behind the Log-in sheet.

**TO BE FILLED IN BY THE GENERATOR**

*Please state the out-of-control event and corrective action suggested in detail below. Retain the original to the individual performing the corrective action and route a copy to the QA Manager. All events which result in missed holding times, insufficient sample volume for prep or analysis, delay in turn-around-time, etc. must be reported to the Project Manager immediately. A copy of the final, completed report must be submitted to the QA Manager.*

SAMPLE PREPARATION/ANALYSIS: \_\_\_\_\_ EPISODE: \_\_\_\_\_

GENERATED BY \_\_\_\_\_ DATE GENERATED: \_\_\_\_\_

PROBLEM \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

CORRECTIVE ACTION SUGGESTED \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

ROUTE A COPY TO THE SUPERVISOR AND QA MANAGER

**TO BE FILLED IN BY THE PERFORMER**

*Please state in detail the corrective actions taken, the result of these actions, how the system has returned to control, and how the events may be prevented in the future. Return original form to generator.*

PERFORMED BY \_\_\_\_\_ DATE PERFORMED: \_\_\_\_\_

CORRECTIVE ACTION TAKEN \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Z:\NETDATA\FORMSADMIN\CAR0194.DOC RETURN TO GENERATOR

SUPERVISOR APPROVAL: \_\_\_\_\_ DATE \_\_\_\_\_

QA MANAGER APPROVAL \_\_\_\_\_ DATE \_\_\_\_\_

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# **QUALITY ASSURANCE PLAN FOR CHEMICAL ANALYSIS**

## **APPENDIX A**

### **PDP PERTINENT QC AND METHOD CRITERIA**

**HQ Air Force Center for Environmental Excellence (AFCEE)  
Quality Assurance Plan  
Version 3.0  
March 1998**



---

**PDP Analytical Services  
1680 Lake Front Circle, Suite B  
The Woodlands, TX 77380**

## Quality Assurance Plan for Chemical Analysis

Document ID: PDP-QAP-02.1

Effective: June 30, 1999

## Appendix A

## APPENDIX A

## PDP PERTINENT QC AND METHOD CRITERIA

HQ Air Force Center for Environmental Excellence (AFCEE)

Quality Assurance Plan

Version 3.0

March 1998

~~RCN: uncontrolled~~~~TO: \_\_\_\_\_~~~~BY: MS~~~~DATE: 01/18/00~~~~RTN: \_\_\_\_\_~~

687 309

**Quality Assurance Plan for Chemical Analysis**

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**Appendix A**

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**QUALITY ASSURANCE PLAN FOR CHEMICAL ANALYSIS**

**Appendix A - AFCEE QAP 3.0**


**Document ID: PDP - QAP - 02.1**

**Effective June 30, 1999**

**Supersedes 2.0 (May 1, 1999)**

  
\_\_\_\_\_  
**Michelle L. Zwingman**  
**Quality Assurance Manager**

6/30/99  
\_\_\_\_\_  
**Date**

  
\_\_\_\_\_  
**Reddy Pakanati**  
**Vice President**

7/2/99  
\_\_\_\_\_  
**Date**

**Future Reviews and Date**

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## Quality Assurance Plan for Chemical Analysis

Document ID: PDP-QAP-02.1

Effective: June 30, 1999

## Appendix A

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REVISION REQUEST FORM

You are a copyholder of the Quality Assurance Plan (QAP) Appendix A for PDP Analytical Services. This is a controlled document and has been assigned a unique record control number (RCN) as found below.

As a copyholder, you have the option to receive all revisions of this manual. Should you desire the most recent revision update, please complete the information requested below, tear off that section, and return it to the attention of the QA Manager at PDP Analytical Services, 1680 Lake Front Circle Drive, Suite B, The Woodlands, TX 77380.

Should you no longer desire custody of this manual, please notify the QA Manager at PDP Analytical Services, 1680 Lake Front Circle Drive, Suite B, The Woodlands, TX 77380. Arrangements for the return of this document and all revisions will be made.

---

**Quality Assurance Plan for Chemical Analysis - Appendix A**  
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**PDP Analytical Services**  
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**Quality Assurance Plan for Chemical Analysis****Document ID: PDP-QAP-02.1****Effective: June 30, 1999****2****Appendix A***AFCEE QAPP**Version 3.0**March 1998**Page 7-14***7.2.2 Method SW8015 (Modified)-Volatile and Extractable Total Petroleum Hydrocarbons**

Volatile petroleum hydrocarbon components, such as gasoline, jet fuel, and other low molecular weight petroleum products, are analyzed by the direct purge and trap technique described in method SW5030B followed by a modified approach to method SW8015. Extractable TPH components are analyzed by extraction method SW3520C or SW3550B followed by a modified method SW8015.

For volatile TPH, the sample is placed in the purge and trap sparge vessel and analysis is conducted using a GC equipped with a FID.

Extractable TPH components, such as kerosene, diesel, motor oil, and other high molecular weight extractable petroleum products, are analyzed by method SW3520C (continuous liquid/liquid extraction) for water-based matrices or by method SW3550B (sonication extraction) for soil/sludge matrices. The sample is extracted and analysis is accomplished on a GC equipped with a capillary or megabore column and a FID. RLs for volatile TPH and extractable TPH are provided in Table 7.2.2-1.

Identification and quantitation of TPH components require more analytical judgment than other GC methods. The TPH chromatograms consist of groups of peaks that fall within a noted carbon retention time range (i.e., number of carbon atoms in the molecule). Standard fuel components are used to calibrate the instruments. The total petroleum hydrocarbons results are reported in mg/Kg or mg/L based on quantitation of the total area count for the gasoline range organics (i.e., C6-C10) or the diesel range organics (i.e., C10-C28). The retention time window shall be set such that the window encompasses only the C6 through C28 range of organics. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.2-2 and 7.2.2-3. Second column confirmation is not required.

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Table 7.2.2-1. RLs for Method SW8015 (Modified)

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Petroleum Hydrocarbons SW8015 (Mod)	Gasoline	0.1	mg/L	1.0	mg/Kg
	Diesel	1.0	mg/L	10.0	mg/Kg
	Jet Fuel	1.0	mg/L	10.0	mg/Kg

Table 7.2.2-2. QC Acceptance Criteria for Method SW8015 (Modified)

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8015 (Modified) GRO	TPH-Gasoline	67-136	≤ 30	57-146	≤ 50
	<i>Surrogate:</i> Chlorobenzene	74-138		64-148	
SW8015 (Modified) DRO	TPH-Diesel	61-143	≤ 30	51-153	≤ 50
	TPH-Jet Fuel	61-143	≤ 30	51-153	≤ 50
	<i>Surrogates (choose 2):</i>				
	Octacosane	26-152		25-162	
	Ortho-Terphenyl	57-132		47-142	
	Fluorobenzene	75-125		65-135	
	Tricontane	40-140		30-150	

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Table 7.2.2-3. Summary of Calibration and QC Procedures for Method SW8015 (Modified)

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8015 (mod)	Volatile and Extractable Total Petroleum Hydrocarbons	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	linear - mean RSD for all analytes $\leq 20\%$ with no individual analyte RSD $> 30\%$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
				linear - least squares regression $r > 0.995$		
				non-linear - COD $\geq 0.990$ (6 points shall be used for second order, 7 points shall be used for third order)		
		Initial calibration verification	Daily, before sample analysis	All concentration levels of GRO within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration

## Quality Assurance Plan for Chemical Analysis

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## Appendix A

Table 7.2.2-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8015 (mod)	Volatile and Extractable Total Petroleum Hydrocarbons	Calibration verification	After every 10 samples and at the end of the analysis sequence	All concentration levels within $\pm 15\%$ of initial calibration	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.2-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No TPH detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

## Quality Assurance Plan for Chemical Analysis

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## Appendix A

Table 7.2.2-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8015 (mod)	Volatile and Extractable Total Petroleum Hydrocarbons	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.2-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch;  if the LCS %R > UCL, apply J to all positive results  if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.2-2	Correct problem then re-extract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results  if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects  If any surrogate recovery is < 10%, apply R to all results



## Quality Assurance Plan for Chemical Analysis

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## Appendix A

Table 7.2.2-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8015 (mod)	Volatile and Extractable Total Petroleum Hydrocarbons	MS/ MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.2-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Retention time window calculated	Each initial calibration	GRO - calculate retention time based on 2-methylpentane and 1,2,4-trimethylbenzene (see 7.4.2 in method) DRO - calculate retention time based on C10 and C28 alkanes (see 7.4.3 in method)	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to the result for EDB in the sample

**Quality Assurance Plan for Chemical Analysis****Document ID: PDP-QAP-02.1****Effective: June 30, 1999****8****Appendix A****Table 7.2.2-3. Concluded**

<b>Method</b>	<b>Applicable Parameter</b>	<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action<sup>a</sup></b>	<b>Flagging Criteria<sup>b</sup></b>
SW8015 (mod)	Volatile and Extractable Total Petroleum Hydrocarbons	MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.2-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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*AFCEE QAPP**Version 3.0**March 1998**Page 7-19***7.2.3 Method SW8021B- Aromatic and Halogenated Volatile Organics**

Aromatic and halogenated volatile organics in water and soil samples are analyzed using method SW8021B. This method is a purge and trap GC method using preparation method SW5030B. A temperature program is used in the GC to separate the compounds. Detection is achieved by a PID and an electrolytic conductivity detector (HECD) in series. The RLs for the analytes are presented in Table 7.2.3-1. Requirements for confirmation of analytes are described in Section 4.5.2. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.3-2 and 7.2.3-3.

For analytes detected by both detectors, no further confirmation need be performed. For analytes detected by only one detector, confirmation on another column is required.

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Table 7.2.3-1. RLs for Method SW8021B

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Aromatic and Halogenated Volatile Organics SW8021B	1,1,1,2-Tetrachloroethane	0.10	µg/L	0.01	mg/Kg
	1,1,1-TCA	0.30	µg/L	0.01	mg/Kg
	1,1,2,2-Tetrachloroethane	0.10	µg/L	0.01	mg/Kg
	1,1,2-TCA	0.30	µg/L	0.01	mg/Kg
	1,1-DCA	0.70	µg/L	0.01	mg/Kg
	1,1-DCE	0.70	µg/L	0.01	mg/Kg
	1,1-Dichloropropene	0.20	µg/L	0.01	mg/Kg
	1,2,3-Trichlorobenzene	0.30	µg/L	0.01	mg/Kg
	1,2,3-Trichloropropane	4.00	µg/L	0.01	mg/Kg
	1,2,4-Trichlorobenzene	0.30	µg/L	0.01	mg/Kg
	1,2,4-Trimethylbenzene	0.5	µg/L	0.01	mg/Kg
	1,2-Dibromo-3-chloropropane	30.0	µg/L	0.01	mg/Kg
	1,2-Dibromoethane	8.00	µg/L	0.01	mg/Kg
	1,2-DCA	0.30	µg/L	0.01	mg/Kg
	1,2-DCB	0.50	µg/L	0.01	mg/Kg
	1,2-Dichloropropane	0.10	µg/L	0.01	mg/Kg
	1,3,5-Trimethylbenzene	0.10	µg/L	0.01	mg/Kg
	1,3-DCB	0.20	µg/L	0.01	mg/Kg
	1,3-Dichloropropane	0.30	µg/L	0.01	mg/Kg
	1,4-DCB	0.10	µg/L	0.01	mg/Kg
	2,2-Dichloropropane	0.50	µg/L	0.01	mg/Kg
	2-Chlorotoluene	0.10	µg/L	0.01	mg/Kg
	4-Chlorotoluene	0.20	µg/L	0.01	mg/Kg
	Benzene	0.10	µg/L	0.01	mg/Kg
	Bromobenzene	0.10	µg/L	0.01	mg/Kg
	Bromochloromethane	0.10	µg/L	0.01	mg/Kg
	Bromodichloromethane	0.20	µg/L	0.01	mg/Kg
	Bromoform	16.0	µg/L	0.01	mg/Kg
	Bromomethane	11.00	µg/L	0.01	mg/Kg
	Carbon Tetrachloride	0.10	µg/L	0.01	mg/Kg
	Chlorobenzene	0.10	µg/L	0.01	mg/Kg
	Chloroethane	1.00	µg/L	0.01	mg/Kg
	Chloroform	0.20	µg/L	0.01	mg/Kg

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Table 7.2.3-1. Concluded

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Aromatic and Halogenated Volatile Organics SW8021B	Chloromethane	0.30	µg/L	0.01	mg/Kg
	Cis-1,2-DCE	0.60	µg/L	0.01	mg/Kg
	Cis-1,3-Dichloropropene	0.30	µg/L	0.01	mg/Kg
	Dibromochloromethane	0.50	µg/L	0.01	mg/Kg
	Dibromomethane	22.0	µg/L	0.01	mg/Kg
	Dichlorodifluoromethane	0.50	µg/L	0.01	mg/Kg
	EDB	8.00	µg/L	0.01	mg/Kg
	Ethylbenzene	0.50	µg/L	0.01	mg/Kg
	Hexachlorobutadiene	0.60	µg/L	0.01	mg/Kg
	Isopropylbenzene	0.50	µg/L	0.01	mg/Kg
	m-Xylene	0.10	µg/L	0.01	mg/Kg
	Methylene Chloride	0.20	µg/L	0.01	mg/Kg
	n-Butylbenzene	0.50	µg/L	0.01	mg/Kg
	n-Propylbenzene	0.10	µg/L	0.01	mg/Kg
	Naphthalene	0.60	µg/L	0.01	mg/Kg
	o-Xylene	0.20	µg/L	0.01	mg/Kg
	p-Isopropyltoluene	0.10	µg/L	0.01	mg/Kg
	p-Xylene	0.10	µg/L	0.01	mg/Kg
	Sec-Butylbenzene	0.20	µg/L	0.01	mg/Kg
	Styrene	0.10	µg/L	0.01	mg/Kg
	TCE	0.20	µg/L	0.01	mg/Kg
	Tert-Butylbenzene	0.60	µg/L	0.01	mg/Kg
	Tetrachloroethylene	0.50	µg/L	0.01	mg/Kg
	Toluene	0.10	µg/L	0.01	mg/Kg
	Trans-1,2-DCE	0.60	µg/L	0.01	mg/Kg
	Trans-1,3-Dichloropropene	1.00	µg/L	0.01	mg/Kg
	Trichlorofluoromethane	0.30	µg/L	0.01	mg/Kg
	Vinyl Chloride	0.40	µg/L	0.01	mg/Kg
	Xylenes, Total	0.50	µg/L	0.01	mg/Kg

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Table 7.2.3-2. QC Acceptance Criteria for Method SW8021B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8021B	1,1,1,2-Tetrachloroethane	75-125	≤ 20	65-125	≤ 30
	1,1,1-TCA	69-134	≤ 20	59-134	≤ 30
	1,1,2,2-Tetrachloroethane	30-166	≤ 20	25-166	≤ 30
	1,1,2-TCA	61-130	≤ 20	51-130	≤ 30
	1,1-DCA	64-127	≤ 20	54-127	≤ 30
	1,1-DCE	53-147	≤ 20	43-147	≤ 30
	1,1-Dichloropropene	65-135	≤ 20	55-145	≤ 30
	1,2,3-Trichlorobenzene	65-135	≤ 20	55-145	≤ 30
	1,2,3-Trichloropropane	75-125	≤ 20	65-125	≤ 30
	1,2,4-Trichlorobenzene	65-135	≤ 20	55-145	≤ 30
	1,2,4-Trimethylbenzene	65-135	≤ 20	55-145	≤ 30
	1,2-Dibromo-3-chloropropane	65-135	≤ 20	55-145	≤ 30
	1,2-Dibromoethane	65-135	≤ 20	55-145	≤ 30
	1,2-DCA	68-137	≤ 20	58-137	≤ 30
	1,2-DCB	61-134	≤ 20	51-134	≤ 30
	1,2-Dichloropropane	73-125	≤ 20	63-125	≤ 30
	1,3,5-Trimethylbenzene	65-135	≤ 20	55-145	≤ 30
	1,3-DCB	63-137	≤ 20	53-137	≤ 30
	1,3-Dichloropropane	65-135	≤ 20	55-145	≤ 30
	1,4-DCB	66-135	≤ 20	56-135	≤ 30
	2,2-Dichloropropane	65-135	≤ 20	55-145	≤ 30
	2-Chlorotoluene	65-135	≤ 20	55-145	≤ 30
	4-Chlorotoluene	65-135	≤ 20	55-145	≤ 30
	Benzene	75-125	≤ 20	65-125	≤ 30
	Bromobenzene	75-125	≤ 20	65-125	≤ 30
	Bromochloromethane	65-135	≤ 20	55-145	≤ 30
	Bromodichloromethane	61-135	≤ 20	51-135	≤ 30
	Bromoform	58-129	≤ 20	48-129	≤ 30
	Bromomethane	68-125	≤ 20	58-125	≤ 30
	Carbon Tetrachloride	69-139	≤ 20	59-139	≤ 30
	Chlorobenzene	75-129	≤ 20	65-129	≤ 30
	Chloroethane	75-130	≤ 20	65-130	≤ 30

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Table 7.2.3-2. Concluded

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8021B	Chloroform	49-133	≤ 20	39-133	≤ 30
	Chloromethane	59-154	≤ 20	49-154	≤ 30
	Cis-1,2-DCE	75-120	≤ 20	65-125	≤ 30
	Cis-1,3-Dichloropropene	75-130	≤ 20	65-130	≤ 30
	Dibromochloromethane	75-131	≤ 20	65-131	≤ 30
	Dibromomethane	65-135	≤ 20	55-145	≤ 30
	Dichlorodifluoromethane	68-125	≤ 20	58-125	≤ 30
	EDB	75-131	≤ 20	65-131	≤ 30
	Ethylbenzene	71-129	≤ 20	61-129	≤ 30
	Hexachlorobutadiene	65-135	≤ 20	55-145	≤ 30
	Isopropylbenzene	65-135	≤ 20	55-145	≤ 30
	m-Xylene	65-135	≤ 20	55-145	≤ 30
	Methylene Chloride	42-176	≤ 20	32-176	≤ 30
	n-Butylbenzene	65-135	≤ 20	55-145	≤ 30
	n-Propylbenzene	65-135	≤ 20	55-145	≤ 30
	Naphthalene	65-135	≤ 20	55-145	≤ 30
	o-Xylene	65-135	≤ 20	55-145	≤ 30
	p-Isopropyltoluene	65-135	≤ 20	55-145	≤ 30
	p-Xylene	65-135	≤ 20	55-145	≤ 30
	Sec-Butylbenzene	65-135	≤ 20	55-145	≤ 30
	Styrene	65-135	≤ 20	55-145	≤ 30
	TCE	75-141	≤ 20	65-141	≤ 30
	Tert-Butylbenzene	65-135	≤ 20	55-145	≤ 30
	Tetrachloroethene	75-142	≤ 20	65-142	≤ 30
	Toluene	70-125	≤ 20	60-125	≤ 30
	Trans-1,2-DCE	75-130	≤ 20	68-130	≤ 30
	Trans-1,3-Dichloropropene	42-156	≤ 20	32-156	≤ 30
	Trichlorofluoromethane	75-130	≤ 20	69-130	≤ 30
	Vinyl Chloride	47-142	≤ 20	37-142	≤ 30
	Xylenes, Total	71-133	≤ 20	61-133	≤ 30
	<i>Surrogates:</i>				
	1,4-Dichlorobutane	35-135		35-135	
	Bromochlorobenzene	37-137		37-137	

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Table 7.2.3-3. Summary of Calibration and QC Procedures for Method SW8021B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8021B	Aromatic and Halo-genated volatile organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	linear - mean RSD for all analytes $\leq 20\%$ with no individual analyte RSD $> 30\%$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
				linear - least squares regression $r > 0.995$		
				non-linear - COD $\geq 0.990$ (6 points shall be used for second order, 7 points shall be used for third order)		
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration



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Table 7.2.3-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8021B	Aromatic and Halo-genated volatile organics	Retention time window calculated for each analyte	Each initial calibration and calibration verifications	$\pm 3$ times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value (for low boiling compounds, see footnote c)	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value (for low boiling compounds, see footnote c)	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.3-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst

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Table 7.2.3-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8021B	Aromatic and Halo-genated volatile organics	Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.3-2	Re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch;  if the LCS %R > UCL, apply J to all positive results  if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

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Table 7.2.3-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8021B	Aromatic and Halogenated volatile organics	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.3-2	Correct problem then re-extract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results
	Halogenated volatile organics	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.3-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL

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Table 7.2.3-3. Concluded

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8021B	Aromatic and Halo-genated volatile organics	Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample not confirmed.  Apply J if RPD >40% from first column result
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.3-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

c. Bromomethane, chloroethane, chloromethane, dichlorodifluoromethane, trichlorofluoromethane and vinyl chloride may be within  $\pm 20\%$  of expected value.

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### **7.2.5 Method SW8081A-Organochlorine Pesticides**

Organochlorine pesticides in water and soil samples are analyzed using method SW8081A. This analytical method involves the extraction of the samples. The pesticides are then separated and quantified by GC using electron capture detection. Reporting limits (RLs) for this method are presented in Table 7.2.5-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.5-2 and 7.2.5-3.

A second-column confirmation is not required for the analysis of toxaphene or chlordane.

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Table 7.2.5-1. RLs for Method SW8081A

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Organochlorine Pesticides SW8081A	$\alpha$ -BHC	0.35	$\mu\text{g/L}$	0.019	mg/Kg
	$\beta$ -BHC	0.23	$\mu\text{g/L}$	0.033	mg/Kg
	$\delta$ -BHC	0.24	$\mu\text{g/L}$	0.011	mg/Kg
	$\gamma$ -BHC (Lindane)	0.25	$\mu\text{g/L}$	0.020	mg/Kg
	$\alpha$ -Chlordane	0.80	$\mu\text{g/L}$	0.015	mg/Kg
	$\gamma$ -Chlordane	0.37	$\mu\text{g/L}$	0.015	mg/Kg
	4,4'-DDD	0.50	$\mu\text{g/L}$	0.042	mg/Kg
	4,4'-DDE	0.58	$\mu\text{g/L}$	0.025	mg/Kg
	4,4'-DDT	0.81	$\mu\text{g/L}$	0.036	mg/Kg
	Aldrin	0.34	$\mu\text{g/L}$	0.022	mg/Kg
	Dieldrin	0.44	$\mu\text{g/L}$	0.035	mg/Kg
	Endosulfan I	0.30	$\mu\text{g/L}$	0.021	mg/Kg
	Endosulfan II	0.40	$\mu\text{g/L}$	0.024	mg/Kg
	Endosulfan Sulfate	0.35	$\mu\text{g/L}$	0.036	mg/Kg
	Endrin	0.39	$\mu\text{g/L}$	0.036	mg/Kg
	Endrin Aldehyde	0.50	$\mu\text{g/L}$	0.016	mg/Kg
	Heptachlor	0.40	$\mu\text{g/L}$	0.020	mg/Kg
	Heptachlor Epoxide	0.32	$\mu\text{g/L}$	0.021	mg/Kg
	Methoxychlor	0.86	$\mu\text{g/L}$	0.057	mg/Kg
	Toxaphene	0.50	$\mu\text{g/L}$	0.57	mg/Kg

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Table 7.2.5-2. QC Acceptance Criteria for Method SW8081A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8081A	$\alpha$ -BHC	75-125	$\leq 30$	65-135	$\leq 50$
	$\beta$ -BHC	51-125	$\leq 30$	41-133	$\leq 50$
	$\delta$ -BHC	75-126	$\leq 30$	65-136	$\leq 50$
	$\gamma$ -BHC (Lindane)	73-125	$\leq 30$	63-130	$\leq 50$
	$\alpha$ -Chlordane	41-125	$\leq 30$	31-135	$\leq 50$
	$\gamma$ -Chlordane	41-125	$\leq 30$	31-133	$\leq 50$
	4,4-DDD	48-136	$\leq 30$	38-146	$\leq 50$
	4,4-DDE	45-139	$\leq 30$	35-149	$\leq 50$
	4,4-DDT	34-143	$\leq 30$	25-153	$\leq 50$
	Aldrin	47-125	$\leq 30$	37-126	$\leq 50$
	Dieldrin	42-132	$\leq 30$	32-142	$\leq 50$
	Endosulfan I	49-143	$\leq 30$	39-153	$\leq 50$
	Endosulfan II	75-159	$\leq 30$	65-169	$\leq 50$
	Endosulfan Sulfate	46-141	$\leq 30$	36-151	$\leq 50$
	Endrin	43-134	$\leq 30$	33-144	$\leq 50$
	Endrin Aldehyde	75-150	$\leq 30$	65-160	$\leq 50$
	Heptachlor	45-128	$\leq 30$	35-138	$\leq 50$
	Heptachlor Epoxide	53-134	$\leq 30$	43-144	$\leq 50$
	Methoxychlor	73-142	$\leq 30$	63-152	$\leq 50$
	Toxaphene	41-126	$\leq 30$	31-136	$\leq 50$
	<i>Surrogates:</i>				
	DCBP	34-133		25-143	
	TCMX	45-125		35-135	

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Table 7.2.5-3. Summary of Calibration and QC Procedures for Method SW8081A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8081A	Organo-chlorine pesticides	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	linear - mean RSD for all analytes $\leq 20\%$ with no individual analyte RSD $> 30\%$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
				linear - least squares regression $r > 0.995$		
				non-linear - COD $\geq 0.990$ (6 points shall be used for second order, 7 points shall be used for third order)		
		Second-source calibration verification for all analytes	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration



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Table 7.2.5-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8081A	Organo-chlorine pesticides	Retention time window calculated for each analyte	Each initial calibration and calibration verifications	$\pm 3$ times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification

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Table 7.2.5-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8081A	Organo-chlorine pesticides	Breakdown check (Endrin and DDT)	Daily prior to analysis of samples	Degradation $\leq 15\%$	Repeat breakdown check	Apply J to all positive DDT, DDE, DDD, endrin, endrin ketone and endrin aldehyde results; apply R to the analytes listed above if minimum frequency is not met
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.5-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

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Table 7.2.5-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8081A	Organo-chlorine pesticides	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.5-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.5-2	Correct problem then re-extract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results

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Table 7.2.5-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8081A	Organo-chlorine pesticides	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.5-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation (excluding toxaphene and chlordane)	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample not confirmed.  Apply J if RPD >40% from first column result
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.5-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed

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<b>Method</b>	<b>Applicable Parameter</b>	<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action<sup>a</sup></b>	<b>Flagging Criteria<sup>b</sup></b>
SW8081A	Organo-chlorine pesticides	Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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***AFCEE QAPP******Version 3.0******March 1998******Page 7-53*****7.2.8 Method SW8151A-Chlorinated Herbicides**

Method SW8151A is a capillary GC method for determining selected chlorinated acid herbicides and related compounds. Samples are extracted then esterified. The esters are determined by GC employing an electron capture detector. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column. RLs for herbicides are presented in Table 7.2.8-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.8-2 and 7.2.8-3.

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Table 7.2.8-1. RLs for Method SW8151A

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Chlorinated Phenoxy Acid Herbicides SW8151A	2,4-D	2.0	µg/L	0.001	mg/Kg
	2,4-DB	8.0	µg/L	10.0	mg/Kg
	2,4,5-T	0.80	µg/L	0.5	mg/Kg
	2,4,5-TP	0.75	µg/L	0.003	mg/Kg
	Dalapon	13.0	µg/L	0.01	mg/Kg
	Dicamba	0.81	µg/L	0.5	mg/Kg
	Dichloroprop	2.6	µg/L	2.0	mg/Kg
	Dinoseb	1.9	µg/L	2.7	mg/Kg
	MCPA	0.56	µg/L	0.43	mg/Kg
	MCP	0.9	µg/L	0.66	mg/Kg

Table 7.2.8-2. QC Acceptance Criteria for Method SW8151A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8151A	2,4-D	65-125	≤ 30	55-135	≤ 50
	2,4-DB	65-125	≤ 30	55-135	≤ 50
	2,4,5-T	71-125	≤ 30	61-135	≤ 50
	2,4,5-TP	75-125	≤ 30	65-135	≤ 50
	Dalapon	70-125	≤ 30	60-135	≤ 50
	Dicamba	59-125	≤ 30	49-135	≤ 50
	Dichloroprop	63-125	≤ 30	53-135	≤ 50
	Dinoseb	72-125	≤ 30	62-135	≤ 50
	MCPA	64-125	≤ 30	54-135	≤ 50
	MCP	75-125	≤ 30	65-135	≤ 50
	<i>Surrogate:</i> 2,4-Dichlorophenylacetic acid	61-136		51-146	

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Table 7.2.8-3. Summary of Calibration and QC Procedures for Method SW8151A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8151A	Chlorinated Herbicides	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	linear - mean RSD for all analytes $\leq 20\%$ with no individual analyte RSD $> 30\%$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
				linear – least squares regression $r > 0.995$		
				non-linear – COD $\geq 0.990$ (6 points shall be used for second order, 7 points shall be used for third order)		
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration



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Table 7.2.8-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8151A	Chlorinated Herbicides	Retention time window calculated for each analyte	Each initial calibration and calibration verifications	$\pm 3$ times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.8-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst

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Table 7.2.8-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8151A	Chlorinated Herbicides	Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.8-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch;  if the LCS %R > UCL, apply J to all positive results  if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

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Table 7.2.8-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8151A	Chlorinated Herbicides	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.8-2	Correct problem then re-extract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results  if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects  If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.8-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL

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Table 7.2.8-3. Concluded

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8151A	Chlorinated Herbicides	Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample not confirmed.  Apply J if RPD >40% from first column result
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.8-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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*AFCEE QAPP**Version 3.0**March 1998**Page 7-58***7.2.9 Method SW8260B-Volatile Organics**

Volatile (or purgeable) organics in water and soil samples are analyzed using method SW8260B. This method uses a capillary column GC/mass spectrometry technique. Volatile compounds are introduced into the GC by purge and trap (SW5030B). An inert gas is bubbled through the water samples (or a soil-water slurry for soil samples) to transfer the purgeable organic compounds from the liquid to vapor phase. Soil samples with higher contaminant levels are extracted using methanol before purging. The vapor is then swept through a sorbent trap where the purgeable organics are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a capillary GC column where they are separated and then detected with a mass spectrometer. The analytes detected and RLs (using a 25 mL purge) for this method are listed in Table 7.2.9-1.

Calibration—The mass spectrometer is tuned daily to give an acceptable spectrum for BFB. The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- mass 50 15 percent to 40 percent of mass 95
- mass 75 30 percent to 60 percent of mass 95
- mass 95 base peak, 100 percent relative abundance
- mass 96 5 percent to 9 percent of mass 95
- mass 173 less than 2 percent of mass 174
- mass 174 greater than 50 percent of mass 95
- mass 175 5 percent to 9 percent of mass 174
- mass 176 greater than 95 percent, but less than 101 percent of mass 174
- mass 177 5 percent to 9 percent of mass 176

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS added to each calibration standard, blank, QC sample, and sample. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.9-2 and 7.2.9-3.

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Table 7.2.9-1. RLs for Method SW8260B (Variance)

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
VOCs SW8260B	1,1,1,2-Tetrachloroethane	1.0	µg/L	0.005	mg/Kg
	1,1,1-TCA	1.0	µg/L	0.005	mg/Kg
	1,1,2,2-Tetrachloroethane	1.0	µg/L	0.005	mg/Kg
	1,1,2-TCA	1.0	µg/L	0.005	mg/Kg
	1,1-DCA	1.0	µg/L	0.005	mg/Kg
	1,1-DCE	1.0	µg/L	0.005	mg/Kg
	1,1-Dichloropropene	1.0	µg/L	0.005	mg/Kg
	1,2,3-Trichlorobenzene	1.0	µg/L	0.005	mg/Kg
	1,2,3-Trichloropropane	1.0	µg/L	0.005	mg/Kg
	1,2,4-Trichlorobenzene	1.0	µg/L	0.005	mg/Kg
	1,2,4-Trimethylbenzene	1.0	µg/L	0.005	mg/Kg
	1,2-DCA	1.0	µg/L	0.005	mg/Kg
	1,2-DCB	1.0	µg/L	0.005	mg/Kg
	1,2-Dibromo-3-chloropropane	2.0	µg/L	0.010	mg/Kg
	1,2-Dichloropropane	1.0	µg/L	0.005	mg/Kg
	1,2-EDB	1.0	µg/L	0.005	mg/Kg
	1,3,5-Trimethylbenzene	1.0	µg/L	0.005	mg/Kg
	1,3-DCB	1.0	µg/L	0.005	mg/Kg
	1,3-Dichloropropane	1.0	µg/L	0.005	mg/Kg
	1,4-DCB	1.0	µg/L	0.005	mg/Kg
	1-Chlorohexane	1.0	µg/L	0.005	mg/Kg
	2,2-Dichloropropane	1.0	µg/L	0.005	mg/Kg
	2-Chlorotoluene	1.0	µg/L	0.005	mg/Kg
	4-Chlorotoluene	1.0	µg/L	0.005	mg/Kg
	Benzene	1.0	µg/L	0.005	mg/Kg
	Bromobenzene	1.0	µg/L	0.005	mg/Kg
	Bromochloromethane	1.0	µg/L	0.005	mg/Kg
	Bromodichloromethane	1.0	µg/L	0.005	mg/Kg
	Bromoform	1.0	µg/L	0.005	mg/Kg
	Bromomethane	2.0	µg/L	0.010	mg/Kg
	Carbon tetrachloride	1.0	µg/L	0.005	mg/Kg
	Chlorobenzene	1.0	µg/L	0.005	mg/Kg
	Chloroethane	2.0	µg/L	0.010	mg/Kg
	Chloroform	1.0	µg/L	0.005	mg/Kg

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Table 7.2.9-1. (Variance) Concluded

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
VOCs SW8260B (concluded)	Chloromethane	2.0	µg/L	0.010	mg/Kg
	Cis-1,2-DCE	1.0	µg/L	0.005	mg/Kg
	Cis-1,3-Dichloropropene	1.0	µg/L	0.005	mg/Kg
	Dibromochloromethane	1.0	µg/L	0.005	mg/Kg
	Dibromomethane	1.0	µg/L	0.005	mg/Kg
	Dichlorodifluoromethane	2.0	µg/L	0.010	mg/Kg
	Ethylbenzene	1.0	µg/L	0.005	mg/Kg
	Hexachlorobutadiene	1.0	µg/L	0.005	mg/Kg
	Isopropylbenzene	1.0	µg/L	0.005	mg/Kg
	m-Xylene	1.0	µg/L	0.005	mg/Kg
	Methylene chloride	1.0	µg/L	0.005	mg/Kg
	n-Butylbenzene	1.0	µg/L	0.005	mg/Kg
	n-Propylbenzene	0.4	µg/L	0.005	mg/Kg
	Naphthalene	0.4	µg/L	0.005	mg/Kg
	o-Xylene	1.0	µg/L	0.005	mg/Kg
	p-Isopropyltoluene	1.0	µg/L	0.005	mg/Kg
	p-Xylene	1.0	µg/L	0.005	mg/Kg
	Sec-Butylbenzene	1.0	µg/L	0.005	mg/Kg
	Styrene	1.0	µg/L	0.005	mg/Kg
	TCE	1.0	µg/L	0.005	mg/Kg
	Tert-Butylbenzene	1.0	µg/L	0.005	mg/Kg
	Tetrachloroethene	1.0	µg/L	0.005	mg/Kg
	Toluene	1.0	µg/L	0.005	mg/Kg
	Trans-1,2-DCE	1.0	µg/L	0.005	mg/Kg
	Trans-1,3-Dichloropropene	1.0	µg/L	0.005	mg/Kg
	Trichlorofluoromethane	1.0	µg/L	0.005	mg/Kg
	Vinyl chloride	2.0	µg/L	0.010	mg/Kg

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Table 7.2.9-2. QC Acceptance Criteria for Method SW8260B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Assoc. IS
SW8260B	1,1,1,2-Tetrachloroethane	72-125	≤ 20	62-108	≤ 30	2
	1,1,1-TCA	75-125	≤ 20	65-135	≤ 30	1
	1,1,2,2-Tetrachloroethane	74-125	≤ 20	64-135	≤ 30	3
	1,1,2-TCA	75-127	≤ 20	65-135	≤ 30	1
	1,1-DCA	72-125	≤ 20	62-135	≤ 30	1
	1,1-DCE	75-125	≤ 20	65-135	≤ 30	1
	1,1-Dichloropropene	75-125	≤ 20	65-135	≤ 30	1
	1,2,3-Trichlorobenzene	75-137	≤ 20	65-147	≤ 30	3
	1,2,3-Trichloropropane	75-125	≤ 20	65-135	≤ 30	3
	1,2,4-Trichlorobenzene	75-135	≤ 20	65-145	≤ 30	3
	1,2,4-Trimethylbenzene	75-125	≤ 20	65-135	≤ 30	3
	1,2-DCA	68-127	≤ 20	58-137	≤ 30	1
	1,2-DCB	75-125	≤ 20	65-135	≤ 30	3
	1,2-Dibromo-3-chloropropane	59-125	≤ 20	49-135	≤ 30	3
	1,2-Dichloropropane	70-125	≤ 20	60-135	≤ 30	1
	1,2-EDB	75-125	≤ 20	65-135	≤ 30	2
	1,3,5-Trimethylbenzene	72-112	≤ 20	62-135	≤ 30	3
	1,3-DCB	75-125	≤ 20	65-135	≤ 30	3
	1,3-Dichloropropane	75-125	≤ 20	65-135	≤ 30	2
	1,4-DCB	75-125	≤ 20	65-135	≤ 30	3
	1-Chlorohexane	75-125	≤ 20	65-135	≤ 30	2
	2,2-Dichloropropane	75-125	≤ 20	65-135	≤ 30	1
	2-Chlorotoluene	73-125	≤ 20	63-135	≤ 30	3
	4-Chlorotoluene	74-125	≤ 20	64-135	≤ 30	3
	Benzene	75-125	≤ 20	65-135	≤ 30	1
	Bromobenzene	75-125	≤ 20	65-135	≤ 30	3
	Bromochloromethane	73-125	≤ 20	63-135	≤ 30	1
	Bromodichloromethane	75-125	≤ 20	65-135	≤ 30	1
	Bromoform	75-125	≤ 20	65-135	≤ 30	2
	Bromomethane	72-125	≤ 20	62-135	≤ 30	1
	Carbon Tetrachloride	62-125	≤ 20	52-135	≤ 30	1
	Chlorobenzene	75-125	≤ 20	65-135	≤ 30	2
	Chloroethane	65-125	≤ 20	55-135	≤ 30	1



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Table 7.2.9-2. Concluded

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Assoc. IS
SW8260B (concluded)	Chloroform	74-125	≤ 20	64-135	≤ 30	1
	Chloromethane	75-125	≤ 20	65-135	≤ 30	1
	Cis-1,2-DCE	75-125	≤ 20	65-135	≤ 30	1
	Cis-1,3-Dichloropropene	74-125	≤ 20	64-135	≤ 30	1
	Dibromochloromethane	73-125	≤ 20	63-135	≤ 30	2
	Dibromomethane	69-127	≤ 20	59-137	≤ 30	1
	Dichlorodifluoromethane	75-125	≤ 20	65-135	≤ 30	1
	Ethylbenzene	75-125	≤ 20	65-135	≤ 30	2
	Hexachlorobutadiene	75-125	≤ 20	65-135	≤ 30	3
	Isopropylbenzene	75-125	≤ 20	65-135	≤ 30	3
	m-Xylene	75-125	≤ 20	65-135	≤ 30	2
	Methylene chloride	75-125	≤ 20	65-135	≤ 30	1
	n-Butylbenzene	75-125	≤ 20	65-135	≤ 30	3
	n-Propylbenzene	75-125	≤ 20	65-135	≤ 30	3
	Naphthalene	75-125	≤ 20	65-135	≤ 30	3
	o-Xylene	75-125	≤ 20	65-135	≤ 30	2
	p-Isopropyltoluene	75-125	≤ 20	65-135	≤ 30	3
	p-Xylene	75-125	≤ 20	65-135	≤ 30	2
	Sec-Butylbenzene	75-125	≤ 20	65-135	≤ 30	3
	Styrene	75-125	≤ 20	65-135	≤ 30	2
	TCE	71-125	≤ 20	61-135	≤ 30	1
	Tert-butylbenzene	75-125	≤ 20	65-135	≤ 30	3
	Tetrachloroethene	71-125	≤ 20	61-135	≤ 30	2
	Toluene	74-125	≤ 20	64-135	≤ 30	1
	Trans-1,2-DCE	75-125	≤ 20	65-135	≤ 30	1
	Trans-1,3-Dichloropropene	66-125	≤ 20	56-135	≤ 30	1
	Trichlorofluoromethane	67-125	≤ 20	57-135	≤ 30	1
	Vinyl Chloride	46-134	≤ 20	36-144	≤ 30	1
	<i>Surrogates:</i>					
	Dibromofluoromethane	75-125		65-135		
	Toluene-D8	75-125		65-135		
	4-Bromofluorobenzene	75-125		65-135		
	1,2-DCA-D4	62-139		52-149		
	<i>Internal Standards:</i>					
	Fluorobenzene					1
	Chlorobenzene-D5					2
	1,4-Dichlorobenzene-D					3

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Table 7.2.9-3. Summary of Calibration and QC Procedures for Method SW8260B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8260B	Volatile Organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs average RF $\geq 0.30^\circ$ and %RSD for RFs for CCCs $\leq 30\%$ and one option below	Correct problem then repeat initial calibration	Apply R to all results for all samples associated with the calibration
				option 1 linear-mean RSD for all analytes $\leq 15\%$ with no individual analyte RSD $> 30\%$		Apply R to all results for specific analyte(s) for all samples associated with the calibration
				option 2 linear – least squares regression $r > 0.995$		
				option 3 non-linear – COD $\geq 0.990$ (6 points shall be used for second order, 7 points shall be used for third order)		

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Table 7.2.9-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8260B	Volatile Organics	Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each sample	Relative retention time (RRT) of the analyte within $\pm 0.06$ RRT units of the RRT	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Calibration verification	Daily, before sample analysis and every 12 hours of analysis time	SPCCs average RF $\geq 0.30\%$ ; and CCCs $\leq 20\%$ difference (when using RFs) or drift (when using least squares regression or non-linear calibration)	Correct problem then repeat initial calibration	Apply R to all results for all samples associated with the calibration verification
				All calibration analytes within $\pm 20\%$ of expected value		Apply R to all results for specific analyte(s) for all samples associated with the calibration verification

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Table 7.2.9-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8260B	Volatile Organics	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.9-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		ISs	Immediately after or during data acquisition for each sample	Retention time $\pm 30$ seconds from retention time of the mid-point std. in the ICAL.  EICP area within -50% to +100% of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Apply R to all results for analytes associated with the IS
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

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Table 7.2.9-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8260B	Volatile Organics	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.9-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch;  if the LCS %R > UCL, apply J to all positive results  if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.9-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3) MS/MSD RPD > CL

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Table 7.2.9-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8260B	Volatile Organics	Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description (section 7.2.9)	Retune instrument and verify	Apply R to all results for all samples associated with the tune
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.9-2	Correct problem then re-extract and analyze sample	For the samples;  if the %R > UCL for a surrogate, apply J to all positive results  if the %R < LCL for a surrogate, apply J to all positive results; apply R to all non-detect results  If any surrogate recovery is <10%, apply R to all results
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.9-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed

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<b>Method</b>	<b>Applicable Parameter</b>	<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action<sup>a</sup></b>	<b>Flagging Criteria<sup>b</sup></b>
SW8260B	Volatile Organics	Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

c. Except > 0.10 for bromoform, and > 0.10 for chloromethane and 1,1-dichloroethane.

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**7.2.10 Method SW8270C-Semivolatile Organics**

Semivolatile organics (also known as base/neutral and acid extractables) in water and soil samples are analyzed using method SW8270C. This technique determines quantitatively the concentration of a number of SVOCs. Samples are extracted and both base/neutral and acid extracts are then concentrated through evaporation. Compounds of interest are separated and quantified using a capillary column GC/mass spectrometer. The RLs are listed in Table 7.2.10-1.

The mass spectrometer is tuned every 12 hours to give an acceptable spectrum for decafluorotriphenylphosphine (DFTPP). The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- mass 51-30 percent to 60 percent of mass 198
- mass 68 less than 2 percent of mass 69
- mass 70 less than 2 percent of mass 69
- mass 127 40 percent to 60 percent of mass 198
- mass 197 less than 1 percent of mass 198
- mass 198 base peak, 100 percent relative abundance
- mass 199 5 percent to 9 percent of mass 198
- mass 275 10 percent to 30 percent of mass 198
- mass 365 greater than 1 percent of mass 198
- mass 441 present, but less than mass 443
- mass 442 greater than 40 percent of mass 198
- mass 443 17 percent to 23 percent of mass 442

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS that is added to each calibration standard, blank, QC sample, and sample. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.10-2 and 7.2.10-3.



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Table 7.2.10-1. RLs for Method SW8270C

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Semivolatile organics Base/Neutral Extractables SW8270C	1,2,4-Trichlorobenzene	10.0	µg/L	0.7	mg/Kg
	1,2-DCB	10.0	µg/L	0.7	mg/Kg
	1,3-DCB	10.0	µg/L	0.7	mg/Kg
	1,4-DCB	10.0	µg/L	0.7	mg/Kg
	2,4-DNT	10.0	µg/L	0.7	mg/Kg
	2,6-DNT	10.0	µg/L	0.7	mg/Kg
	2-Chloronaphthalene	10.0	µg/L	0.7	mg/Kg
	2-Methylnaphthalene	10.0	µg/L	0.7	mg/Kg
	2-Nitroaniline	50.0	µg/L	3.3	mg/Kg
	3-Nitroaniline	50.0	µg/L	3.3	mg/Kg
	3,3'-Dichlorobenzidine	20.0	µg/L	1.3	mg/Kg
	4-Bromophenyl phenyl ether	10.0	µg/L	0.7	mg/Kg
	4-Chloroaniline	20.0	µg/L	1.3	mg/Kg
	4-Chlorophenyl phenyl ether	10.0	µg/L	0.7	mg/Kg
	4-Nitroaniline	50.0	µg/L	3.3	mg/Kg
	Acenaphthylene	10.0	µg/L	0.7	mg/Kg
	Acenaphthene	10.0	µg/L	0.7	mg/Kg
	Anthracene	10.0	µg/L	0.7	mg/Kg
	Benz (a) anthracene	10.0	µg/L	0.7	mg/Kg
	Benzo (a) pyrene	10.0	µg/L	0.7	mg/Kg
	Benzo (b) fluoranthene	10.0	µg/L	0.7	mg/Kg
	Benzo (g,h,i) perylene	10.0	µg/L	0.7	mg/Kg
	Benzyl alcohol	20.0	µg/L	1.3	mg/Kg
	Bis (2-chloroethoxy) methane	10.0	µg/L	0.7	mg/Kg
	Bis (2-chlorethyl) ether	10.0	µg/L	0.7	mg/Kg
	Bis (2-chloroisopropyl) ether	10.0	µg/L	0.7	mg/Kg
	Bis (2-ethylhexyl) phthalate	10.0	µg/L	0.7	mg/Kg
	Butyl benzylphthalate	10.0	µg/L	0.7	mg/Kg
	Chrysene	10.0	µg/L	0.7	mg/Kg
	Di-n-butylphthalate	10.0	µg/L	0.7	mg/Kg
	Di-n-octylphthalate	10.0	µg/L	0.7	mg/Kg
	Dibenz (a,h) anthracene	10.0	µg/L	0.7	mg/Kg
	Dibenzofuran	10.0	µg/L	0.7	mg/Kg
	Diethyl phthalate	10.0	µg/L	0.7	mg/Kg

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Table 7.2.10-1. Concluded

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Semivolatile organics Base/Neutral Extractables SW8270C (concluded)	Dimethyl phthalate	10.0	µg/L	0.7	mg/Kg
	Fluoranthene	10.0	µg/L	0.7	mg/Kg
	Fluorene	10.0	µg/L	0.7	mg/Kg
	Hexachlorobenzene	10.0	µg/L	0.7	mg/Kg
	Hexachlorobutadiene	10.0	µg/L	0.7	mg/Kg
	Hexachlorocyclopentadiene	10.0	µg/L	0.7	mg/Kg
	Hexachloroethane	10.0	µg/L	0.7	mg/Kg
	Indeno (1,2,3-cd) pyrene	10.0	µg/L	0.7	mg/Kg
	Isophorone	10.0	µg/L	0.7	mg/Kg
	n-Nitrosodiphenylamine	10.0	µg/L	0.7	mg/Kg
	n-Nitrosodi-n-propylamine	10.0	µg/L	0.7	mg/Kg
	Naphthalene	10.0	µg/L	0.7	mg/Kg
	Nitrobenzene	10.0	µg/L	0.7	mg/Kg
	Phenanthrene	10.0	µg/L	0.7	mg/Kg
	Pyrene	10.0	µg/L	0.7	mg/Kg
Semivolatile organics Acid Extractables SW8270C	2,4,5-Trichlorophenol	50.0	µg/L	3.3	mg/Kg
	2,4,6-Trichlorophenol	10.0	µg/L	0.3	mg/Kg
	2,4-Dichlorophenol	10.0	µg/L	0.3	mg/Kg
	2,4-Dimethylphenol	10.0	µg/L	0.3	mg/Kg
	2,4-Dinitrophenol	50.0	µg/L	3.3	mg/Kg
	2-Chlorophenol	10.0	µg/L	0.3	mg/Kg
	2-Methylphenol	10.0	µg/L	0.3	mg/Kg
	2-Nitrophenol	10.0	µg/L	0.3	mg/Kg
	4,6-Dinitro-2-methylphenol	50.0	µg/L	3.3	mg/Kg
	4-Chloro-3-methylphenol	20.0	µg/L	1.3	mg/Kg
	4-Methylphenol	10.0	µg/L	0.3	mg/Kg
	4-Nitrophenol	50.0	µg/L	1.6	mg/Kg
	Benzoic acid	50.0	µg/L	1.6	mg/Kg
	Pentachlorophenol	50.0	µg/L	3.3	mg/Kg
	Phenol	10.0	µg/L	0.3	mg/Kg

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Table 7.2.10-2. QC Acceptance Criteria for Method SW8270C

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Assoc. IS	Assoc. Sur.
SW8270C	1,2,4-Trichlorobenzene	44-142	≤ 20	34-152	≤ 30	2	4
	1,2-DCB	42-155	≤ 20	32-135	≤ 30	1	3
	1,3-DCB	36-125	≤ 20	26-135	≤ 30	1	3
	1,4-DCB	30-125	≤ 20	25-135	≤ 30	1	3
	2,4-DNT	39-139	≤ 20	29-149	≤ 30	3	4
	2,6-DNT	51-125	≤ 20	41-135	≤ 30	3	4
	2-Chloronaphthalene	60-125	≤ 20	50-135	≤ 30	3	4
	2-Methylnaphthalene	41-125	≤ 20	31-135	≤ 30	2	5
	2-Nitroaniline	50-125	≤ 20	40-135	≤ 30	3	2
	3,3'-Dichlorobenzidine	29-175	≤ 20	25-175	≤ 30	5	6
	3-Nitroaniline	51-125	≤ 20	41-135	≤ 30	3	2
	4-Bromophenyl phenyl ether	53-127	≤ 20	43-137	≤ 30	4	1
	4-Chloroaniline	45-136	≤ 20	35-146	≤ 30	2	5
	4-Chlorophenyl phenyl ether	51-132	≤ 20	41-142	≤ 30	3	4
	4-Nitroaniline	40-143	≤ 20	30-153	≤ 30	3	2
	Acenaphthylene	47-125	≤ 20	37-135	≤ 30	3	4
	Acenaphthene	49-125	≤ 20	39-135	≤ 30	3	4
	Anthracene	45-165	≤ 20	35-175	≤ 30	4	1
	Benz (a) anthracene	51-133	≤ 20	41-143	≤ 30	5	6
	Benzo (a) pyrene	41-125	≤ 20	31-135	≤ 30	6	6
	Benzo (b) fluoranthene	37-125	≤ 20	27-135	≤ 30	6	6
	Benzo (g,h,i) perylene	34-149	≤ 20	25-159	≤ 30	6	6
	Benzyl alcohol	35-125	≤ 20	25-135	≤ 30	1	3
	Bis (2-chloroethoxy) methane	49-125	≤ 20	39-135	≤ 30	2	5
	Bis (2-chloroethyl) ether	44-125	≤ 20	34-135	≤ 30	1	3
	Bis (2-chloroisopropyl) ether	36-166	≤ 20	26-175	≤ 30	1	3
	Bis (2-ethylhexyl) phthalate	33-129	≤ 20	25-139	≤ 30	5	6
	Butyl benzyl phthalate	26-125	≤ 20	25-135	≤ 30	5	6
	Chrysene	55-133	≤ 20	45-143	≤ 30	5	6
	Di-n-butyl phthalate	34-126	≤ 20	25-136	≤ 30	4	1
	Di-n-octyl phthalate	38-127	≤ 20	28-137	≤ 30	5	6
	Dibenz (a,h) anthracene	50-125	≤ 20	40-135	≤ 30	6	6
	Dibenzofuran	52-125	≤ 20	42-135	≤ 30	3	4

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Table 7.2.10-2. Continued

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Assoc. IS	Assoc. Sur.
SW8270C	Diethyl phthalate	37-125	≤ 20	27-135	≤ 30	3	4
	Dimethyl phthalate	25-175	≤ 20	25-175	≤ 30	3	4
	Fluoranthene	47-125	≤ 20	37-135	≤ 30	4	1
	Fluorene	48-139	≤ 20	38-149	≤ 30	3	2
	Hexachlorobenzene	46-133	≤ 20	36-143	≤ 30	4	1
	Hexachlorobutadiene	25-125	≤ 20	25-135	≤ 30	2	5
	Hexachlorocyclopentadiene	41-125	≤ 20	31-135	≤ 30	3	2
	Hexachloroethane	25-153	≤ 20	25-163	≤ 30	1	3
	Indeno (1,2,3-c,d) pyrene	27-160	≤ 20	25-170	≤ 30	5	6
	Isophorone	26-175	≤ 20	25-175	≤ 30	2	5
	n-Nitrosodi-n-propylamine	37-125	≤ 20	27-135	≤ 30	1	3
	n-Nitrosodiphenylamine	27-125	≤ 20	25-135	≤ 30	4	1
	Naphthalene	50-125	≤ 20	40-135	≤ 30	2	5
	Nitrobenzene	46-133	≤ 20	36-143	≤ 30	2	4
	Phenanthrene	54-125	≤ 20	44-135	≤ 30	4	1
	Pyrene	47-136	≤ 20	37-146	≤ 30	5	6
	2,4,5-Trichlorophenol	25-175	≤ 20	25-175	≤ 30	3	1
	2,4,6-Trichlorophenol	39-128	≤ 20	29-138	≤ 30	3	1
	2,4-Dichlorophenol	46-125	≤ 20	36-135	≤ 30	2	5
	2,4-Dimethylphenol	45-139	≤ 20	35-149	≤ 30	2	5
	2,4-Dinitrophenol	30-151	≤ 20	25-161	≤ 30	3	4
	2-Chlorophenol	41-125	≤ 20	31-135	≤ 30	1	3
	2-Methylphenol	25-125	≤ 20	25-135	≤ 30	1	3
	2-Nitrophenol	44-125	≤ 20	34-135	≤ 30	2	4
	4,6-Dinitro-2-Methyl Phenol	26-134	≤ 20	25-144	≤ 30	4	1
	4-Chloro-3-Methyl Phenol	44-125	≤ 20	34-135	≤ 30	2	5
	4-Methylphenol	33-125	≤ 20	25-135	≤ 30	1	3
	4-Nitrophenol	25-131	≤ 20	25-141	≤ 30	3	2
	Benzoic Acid	25-162	≤ 20	25-172	≤ 30	2	5
	Pentachlorophenol	28-136	≤ 20	38-146	≤ 30	4	1
	Phenol	25-125	≤ 20	25-135	≤ 30	1	5
	<i>Surrogates:</i>					Number	
	2,4,6-Tribromophenol	25-134		25-144		1	
	2-Fluorobiphenyl	43-125		34-135		2	
	2-Fluorophenol	25-125		25-135		3	
	Nitrobenzene-D5	32-125		25-135		4	

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Table 7.2.10-2. Concluded

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Number
	Phenol-D5	25-125		25-135		5
	Terphenyl-D14	42-126		32-136		6
	<i>Internal Standards:</i>					
	1,4-Dichlorobenzene-D4					1
	Naphthalene-D8					2
	Acenaphthalene-D8					3
	Phenanthrene-D10					4
	Chrysene-D12					5
	Perylene-D12					6

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Table 7.2.10-3. Summary of Calibration and QC Procedures for Method SW8270C

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8270C	Semi-Volatile Organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs average RF $\geq 0.050$ and %RSD for RFs for CCCs $\leq 30\%$ and one option below	Correct problem then repeat initial calibration	Apply R to all results for all samples associated with the calibration
				option 1 linear-mean RSD for all analytes $\leq 15\%$ with no individual analyte RSD $> 30\%$		Apply R to all results for specific analyte(s) for all samples associated with the calibration
				option 2 linear – least squares regression $r > 0.995$		
				option 3 non-linear – COD $\geq 0.990$ (6 points shall be used for second order, 7 points shall be used for third order)		

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Table 7.2.10-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8270C	Semi-Volatile Organics	Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each sample	Relative retention time (RRT) of the analyte within $\pm 0.06$ RRT units of the RRT	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Calibration verification	Daily, before sample analysis and every 12 hours of analysis time	SPCCs average RF $\geq 0.050$ ; and CCCs $\leq 20\%$ difference (when using RFs) or drift (when using least squares regression or non-linear calibration)	Correct problem then repeat initial calibration	Apply R to all results for all samples associated with the calibration verification
				All calibration analytes within $\pm 20\%$ of expected value		Apply R to all results for specific analyte(s) for all samples associated with the calibration verification

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Table 7.2.10-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8270C	Semi-Volatile Organics	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.10-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		ISs	Immediately after or during data acquisition for each sample	Retention time $\pm 30$ seconds from retention time of the mid-point std. in the ICAL.  EICP area within -50% to +100% of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Apply R to all results for analytes associated with the IS
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch



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Table 7.2.10-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8270C	Semi-Volatile Organics	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.10-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch;  if the LCS %R > UCL, apply J to all positive results  if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.10-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3) MS/MSD RPD > CL

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Table 7.2.10-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8270C	Semi-Volatile Organics	Check of mass spectral ion intensities using DFTPP	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description (section 7.2.10)	Retune instrument and verify	Apply R to all results for all samples associated with the tune
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.10-2	Correct problem then re-extract and analyze sample	<p>For the samples; if the %R &gt; UCL for a surrogate, apply J to all positive results of analytes associated with the surrogate</p> <p>if the %R &lt; LCL for a surrogate, apply J to all positive results of analytes associated with the surrogate, apply R to all non-detect results of analytes associated with the surrogate</p> <p>If any surrogate recovery is &lt; 10%, apply R to all results of analytes associated with the surrogate</p>

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Table 7.2.10-3. Concluded

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8270C	Semi-Volatile Organics	MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.10-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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*AFCEE QAPP**Version 3.0**March 1998**Page 7-90***7.2.13 Method SW8310—Polynuclear Aromatic Hydrocarbons**

Method SW8310 is used to determine the concentration of ppb levels of selected polynuclear aromatic hydrocarbons (PAHs) in groundwater and soils by HPLC. Samples are extracted then analyzed by direct injection. Detection is by ultraviolet and fluorescent detectors. RLs are listed in Table 7.2.13-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.13-2 and 7.2.13-3.

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Table 7.2.13-1. RLs for Method SW8310

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Polynuclear Aromatic Hydrocarbons SW8310	Acenaphthene	18.0	µg/L	1.2	mg/Kg
	Acenaphthylene	23.0	µg/L	1.54	mg/Kg
	Anthracene	6.6	µg/L	0.44	mg/Kg
	Benzo (a) anthracene	0.13	µg/L	0.009	mg/Kg
	Benzo (a) pyrene	0.23	µg/L	0.015	mg/Kg
	Benzo (b) fluoranthene	0.18	µg/L	0.012	mg/Kg
	Benzo (g,h,i) perylene	0.76	µg/L	0.05	mg/Kg
	Benzo (k) fluoranthene	0.17	µg/L	0.011	mg/Kg
	Chrysene	1.5	µg/L	0.1	mg/Kg
	Dibenzo (a,h) anthracene	0.3	µg/L	0.02	mg/Kg
	Fluoranthene	2.1	µg/L	0.14	mg/Kg
	Fluorene	2.1	µg/L	0.14	mg/Kg
	Indeno (1,2,3-c,d) pyrene	0.43	µg/L	0.03	mg/Kg
	Naphthalene	18.0	µg/L	1.2	mg/Kg
	Phenanthrene	6.4	µg/L	0.42	mg/Kg
	Pyrene	2.7	µg/L	0.18	mg/Kg

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Table 7.2.13-2. QC Acceptance Criteria for Method SW8310

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8310	Acenaphthene	43-130	≤ 30	33-140	≤ 50
	Acenaphthylene	49-125	≤ 30	39-135	≤ 50
	Anthracene	54-125	≤ 30	44-135	≤ 50
	Benzo (a) Anthracene	39-135	≤ 30	29-145	≤ 50
	Benzo (a) Pyrene	52-125	≤ 30	42-135	≤ 50
	Benzo (b) Fluoranthene	31-137	≤ 30	25-147	≤ 50
	Benzo (g,h,i) Perylene	53-125	≤ 30	43-135	≤ 50
	Benzo (k) Fluoranthene	60-129	≤ 30	50-139	≤ 50
	Chrysene	59-134	≤ 30	49-144	≤ 50
	Dibenzo (a,h) Anthracene	51-125	≤ 30	41-135	≤ 50
	Fluoranthene	42-125	≤ 30	32-135	≤ 50
	Fluorene	53-125	≤ 30	43-135	≤ 50
	Indeno (1,2,3-c,d) Pyrene	55-125	≤ 30	45-135	≤ 50
	Naphthalene	43-125	≤ 30	33-135	≤ 50
	Phenanthrene	52-129	≤ 30	42-139	≤ 50
	Pyrene	55-125	≤ 30	45-135	≤ 50
	<i>Surrogates:</i>				
	Terphenyl-D14	25-157		22-167	

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Table 7.2.13-3. Summary of Calibration and QC Procedures for Method SW8310

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8310	PAHs	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	linear - mean RSD of average CF of all analytes $\leq 20\%$ and average CF of individual analyte $< 30\%$ or mean RSD for all analytes $\leq 20\%$ with no individual analyte RSD $> 30\%$ linear - least squares regression $r > 0.995$ non-linear - COD $\geq 0.990$ (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration

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Table 7.2.13-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8310	PAHs	Retention time window calculated for each analyte	Each initial calibration and calibration verifications	$\pm 3$ times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.13-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst



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Table 7.2.13-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8310	PAHs	Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.13-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.13-2	Correct problem then re-extract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results

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Table 7.2.13-3. Concluded

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8310	PAHs	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.13-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Confirmation <sup>c</sup>	100% for all positive results	Same as for initial or primary analysis	Same as for initial or primary analysis	Apply R to the result for the specific analyte(s) in the sample not confirmed. Apply J if RPD >40% from first result
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.13-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

c. Use a second column or different detector

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**AFCEE QAPP****Version 3.0****March 1998****Page 7-98****7.2.14 Method SW8330—Explosive Residues**

Method SW8330 provides HPLC conditions for the detection of ppb levels of certain explosive residues in a water, soil, and sediment matrix. Prior to using this method, appropriate sample preparation techniques must be used.

In the low-level, salting-out method with no evaporation, aqueous samples of low concentration are extracted by a salting-out extraction procedure. An aliquot of the extract is separated on a C-18 reverse-phase column, determined at 254 nm, and confirmed on a cyanide reverse-phase column.

In the high-level direct injection method, aqueous samples of higher concentration can be diluted, filtered, separated on a C-18 reverse-phase column, determined at 254 nm, and confirmed on a cyanide reverse-phase column.

Soil and sediment samples are extracted in an ultrasonic bath and filtered before chromatography.

RLs are listed in Table 7.2.14-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.14-2 and 7.2.14-3.

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Table 7.2.14-1. RLs for Method SW8330

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Explosive Residues SW8330	1,3,5- TNB	7.3	µg/L	0.25	mg/Kg
	1,3- DNB	4.0	µg/L	0.25	mg/Kg
	2,4,6- TNT	6.9	µg/L	0.25	mg/Kg
	2,4-DNT	5.7	µg/L	0.25	mg/Kg
	2,6-DNT	9.4	µg/L	0.26	mg/Kg
	HMX	13.0	µg/L	2.2	mg/Kg
	m-Nitrotoluene	7.9	µg/L	0.25	mg/Kg
	Methyl-2,4,6-trinitrophenylnitramine	44.0	µg/L	0.65	mg/Kg
	Nitrobenzene	7.0	µg/L	0.26	mg/Kg
	o-Nitrotoluene	12.0	µg/L	0.25	mg/Kg
	p-Nitrotoluene	8.5	µg/L	0.25	mg/Kg
	RDX	14.0	µg/L	1.0	mg/Kg

Table 7.2.14-2. QC Acceptance Criteria for Method SW8330

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8330	1,3,5- TNB	75-142	≤ 30	65-152	≤ 50
	1,3- DNB	75-125	≤ 30	65-135	≤ 50
	2,4,6- TNT	75-128	≤ 30	65-138	≤ 50
	2,4-DNT	75-125	≤ 30	65-135	≤ 50
	2,6-DNT	75-129	≤ 30	65-139	≤ 50
	HMX	74-137	≤ 30	64-147	≤ 50
	m-Nitrotoluene	60-134	≤ 30	50-144	≤ 50
	Methyl-2,4,6-Trinitrophenylnitramine	44-142	≤ 30	34-152	≤ 50
	Nitrobenzene	29-134	≤ 30	25-144	≤ 50
	o-Nitrotoluene	75-129	≤ 30	65-139	≤ 50
	p-Nitrotoluene	42-150	≤ 30	32-160	≤ 50
	RDX	75-132	≤ 30	65-142	≤ 50
	Surrogates <sup>a</sup> :				

- a. Use an analyte and its LCS limit from the method that is not expected to be present in the sample as the surrogate.

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Table 7.2.14-3. Summary of Calibration and QC Procedures for Method SW8330

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8330	Explosives	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	linear - mean RSD of . . . average CF of all analytes $\leq 20\%$ and average CF of individual analyte $< 30\%$ or mean RSD for all analytes $\leq 20\%$ with no individual analyte RSD $> 30\%$ linear - least squares regression $r > 0.995$ non-linear - COD $\geq 0.990$ (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration

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Table 7.2.14-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8330	Explosives	Retention time window calculated for each analyte	Each initial calibration and calibration verifications	$\pm 3$ times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.14-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst

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Table 7.2.14-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8330	Explosives	Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.14-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.14-2	Correct problem then re-extract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results

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Table 7.2.14-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW8330	Explosives	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.14-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Confirmation <sup>c</sup>	100% for all positive results	Same as for initial or primary analysis	Same as for initial or primary analysis	Apply R to the result for the specific analyte(s) in the sample not confirmed.  Apply J if RPD >40% from first result
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.14-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed



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<b>Method</b>	<b>Applicable Parameter</b>	<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action<sup>a</sup></b>	<b>Flagging Criteria<sup>b</sup></b>
SW8330	Explosives	Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

c. Use a second column or different detector

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Table 7.2.15-1. RLs for Method SW6010B

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
ICP Screen for Metals SW6010B	Aluminum	0.2	mg/L	22.0	mg/Kg
	Antimony	0.05	mg/L	10.0	mg/Kg
	Arsenic	0.03	mg/L	40.0	mg/Kg
	Barium	0.005	mg/L	1.0	mg/Kg
	Beryllium	0.005	mg/L	1.0	mg/Kg
	Cadmium	0.007	mg/L	0.50	mg/Kg
	Calcium	1.1	mg/L	100	mg/Kg
	Chromium	0.01	mg/L	20	mg/Kg
	Cobalt	0.006	mg/L	10.0	mg/Kg
	Copper	0.01	mg/L	2.0	mg/Kg
	Iron	0.20	mg/L	3.0	mg/Kg
	Lead	0.025	mg/L	10.0	mg/Kg
	Magnesium	0.10	mg/L	100	mg/Kg
	Manganese	0.003	mg/L	2.0	mg/Kg
	Molybdenum	0.015	mg/L	3.0	mg/Kg
	Nickel	0.01	mg/L	2.0	mg/Kg
	Potassium	0.50	mg/L	600	mg/Kg
	Selenium	0.03	mg/L	3.0	mg/Kg
	Silver	0.01	mg/L	1.0	mg/Kg
	Sodium	1.0	mg/L	10.0	mg/Kg
	Thallium	0.08	mg/L	6.0	mg/Kg
	Vanadium	0.01	mg/L	1.0	mg/Kg
	Zinc	0.01	mg/L	1.0	mg/Kg

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Table 7.2.15-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW6010B	ICP Metals	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.15-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		Interference check solution (ICS)	At the beginning of an analytical run	Within $\pm 20\%$ of expected value	Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples	Apply R to all results for specific analyte(s) in all samples associated with the ICS

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Table 7.2.15-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW6010B	ICP Metals	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.15-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Dilution test	Each new sample matrix	1:5 dilution must agree within $\pm 10\%$ of the original determination	Perform post digestion spike addition	Apply J to all sample results if either of following exist: (1) dilution test not run (2) RPD $\geq 10\%$
		Post digestion spike addition	When dilution test fails	Recovery within 75-125% of expected results	Correct problem then reanalyze post digestion spike addition	Apply J to all sample results (for same matrix) for specific analyte(s) for all samples associated with the post digestion spike addition If post digestion spike addition recovery is < 10%, apply R to all sample results (for same matrix) for specific analyte(s) for all samples associated with the post digestion spike addition

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Table 7.2.15-3. Concluded

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW6010B	ICP Metals	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.15-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.15-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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Table 7.2.17-1. RLs for Method SW7041

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
SW7041	Antimony	0.005	mg/L	0.5	mg/Kg

Table 7.2.17-2. QC Acceptance Criteria for Method SW7041

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7041	Antimony	75-125	≤ 15	75-125	≤ 15

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Table 7.2.17-3. Summary of Calibration and QC Procedures for Method SW7041

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7041	Antimony	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq 0.995$ for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected $\geq$ RL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration

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Table 7.2.17-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7041	Antimony	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.1 7-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.1 7-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch;  if the LCS %R > UCL, apply J to all positive results  if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects



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Table 7.2.17-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7041	Antimony	Dilution Test; 1:4 dilution test	Each preparatory batch	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) dilution test not run (2) RPD $\geq 10\%$
		Recovery test	When dilution test fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.17-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.17-1	none	Apply R to all results for the specific analyte in all samples analyzed

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<b>Method</b>	<b>Applicable Parameter</b>	<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action<sup>a</sup></b>	<b>Flagging Criteria<sup>b</sup></b>
SW7041	Antimony	Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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Table 7.2.18-1. RLs for Method SW7060A

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
SW7060A	Arsenic	0.005	mg/L	0.5	mg/Kg

Table 7.2.18-2. QC Acceptance Criteria for Method SW7060A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7060A	Arsenic	74-120	≤ 15	74-120	≤ 15

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Table 7.2.18-3. Summary of Calibration and QC Procedures for Method SW7060A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7060A	Arsenic	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq 0.995$ for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected $\geq$ RL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration

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Table 7.2.18-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7060A	Arsenic	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.1 8-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.1 8-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results; if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

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Table 7.2.18-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7060A	Arsenic	Dilution test; five-fold dilution test	Each preparatory batch	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) dilution test not run (2) $RPD \geq 10\%$
		Recovery test	When dilution test fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.18-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or $MSD > UCL$ or (2)%R for MS or $MSD < LCL$ or (3) $MS/MSD RPD > CL$

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<b>Method</b>	<b>Applicable Parameter</b>	<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action<sup>a</sup></b>	<b>Flagging Criteria<sup>b</sup></b>
SW7060A	Arsenic	MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.18-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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Table 7.2.19-1. RLs for Method SW7131A

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
SW7131A	Cadmium	0.001	mg/L	0.1	mg/Kg

Table 7.2.19-2. QC Acceptance Criteria for Method SW7131A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7131A	Cadmium	80-122	≤ 15	80-122	≤ 15



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Table 7.2.19-3. Summary of Calibration and QC Procedures for Method SW7131A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7131A	Cadmium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq 0.995$ for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected $\geq RL$	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration

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Table 7.2.19-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7131A	Cadmium	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.1 9-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.1 9-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch;  if the LCS %R > UCL, apply J to all positive results  if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

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Table 7.2.19-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7131A	Cadmium	New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.19-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.19-1	none	Apply R to all results for the specific analyte in all samples analyzed

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<b>Method</b>	<b>Applicable Parameter</b>	<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action<sup>a</sup></b>	<b>Flagging Criteria<sup>b</sup></b>
SW7131A	Cadmium	Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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Table 7.2.20-1. RLs for Method SW7191

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
SW7191	Chromium	0.005	mg/L	0.5	mg/Kg

Table 7.2.20-2. QC Acceptance Criteria for Method SW7191

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7191	Chromium	80-121	≤ 15	80-121	≤ 15

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Table 7.2.20-3. Summary of Calibration and QC Procedures for Method SW7191

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7191	Chromium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq 0.995$ for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected $\geq$ RL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration

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Table 7.2.20-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7191	Chromium	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.20-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.20-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results; if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

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Table 7.2.20-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7191	Chromium	New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.20-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL



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<b>Method</b>	<b>Applicable Parameter</b>	<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action<sup>a</sup></b>	<b>Flagging Criteria<sup>b</sup></b>
SW7191	Chromium	MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.20-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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Table 7.2.22-1. RLs for Method SW7421

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
SW7421	Lead	0.005	mg/L	0.5	mg/Kg

Table 7.2.22-2. QC Acceptance Criteria for Method SW7421

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7421	Lead	74-124	≤ 15	74-124	≤ 25

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Table 7.2.22-3. Summary of Calibration and QC Procedures for Method SW7421

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7421	Lead	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq 0.995$ for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected $\geq$ RL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration

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Table 7.2.22-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7421	Lead	Dilution test; five-fold dilution test	Each preparatory batch	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) dilution test not run (2) RPD $\geq 10\%$
		Recovery test	When dilution test fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.22-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.22-1	none	Apply R to all results for the specific analyte in all samples analyzed

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Table 7.2.22-3. Concluded

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7421	Lead	Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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Table 7.2.23-1. RLs for Method SW7470A/SW7471A

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
SW7470A (W) SW7471A (S)	Mercury	0.001	mg/L	0.1	mg/Kg

Table 7.2.23-2. QC Acceptance Criteria for Method SW7470A/SW7471A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7470A/SW7471A	Mercury	77-120	≤ 15	77-120	≤ 25

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Table 7.2.23-3. Summary of Calibration and QC Procedures for Method SW7470A/SW7471A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7470A SW7471A	Mercury	Initial multipoint calibration (minimum 5 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq 0.995$ for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected $\geq$ RL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration

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Table 7.2.23-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7470A SW7471A	Mercury	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.2 3-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.2 3-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results; if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects



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Table 7.2.23-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7470A SW7471A	Mercury	Dilution test; five-fold dilution test	Each preparatory batch	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) dilution test not run (2) RPD $\geq 10\%$
		Recovery test	When dilution test fails	Recovery within 85- 115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85- 115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.23-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL

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Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7470A SW7471A	Mercury	MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.23-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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Table 7.2.25-1. RLs for Method SW7740

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
SW7740	Selenium	0.005	mg/L	0.5	mg/Kg

Table 7.2.25-2. QC Acceptance Criteria for Method SW7740

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7740	Selenium	73-122	≤ 15	73-122	≤ 25

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Table 7.2.25-3. Summary of Calibration and QC Procedures for Method SW7740

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7740	Selenium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq 0.995$ for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected $\geq$ RL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration

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## Appendix A

Table 7.2.25-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7740	Selenium	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.25-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.25-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results; if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

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Table 7.2.25-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7740	Selenium	Dilution test; five-fold dilution test	Each preparatory batch	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) dilution test not run (2) RPD $\geq 10\%$
		Recovery test	When dilution test fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.25-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.25-1	none	Apply R to all results for the specific analyte in all samples analyzed

**Quality Assurance Plan for Chemical Analysis****Document ID: PDP-QAP-02.1****Effective: June 30, 1999****112****Appendix A****Table 7.2.25-3. Concluded**

<b>Method</b>	<b>Applicable Parameter</b>	<b>QC Check</b>	<b>Minimum Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action<sup>a</sup></b>	<b>Flagging Criteria<sup>b</sup></b>
SW7740	Selenium	Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

**Quality Assurance Plan for Chemical Analysis****Document ID: PDP-QAP-02.1****Effective: June 30, 1999****113****Appendix A***AFCEE QAPP**Version 3.0**March 1998**Page 7-162***Table 7.2.26-1. RLs for Method SW7841**

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
SW7841	Thallium	0.001	mg/L	0.1	mg/Kg

**Table 7.2.26-2. QC Acceptance Criteria for Method SW7841**

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7841	Thallium	78-123	≤ 15	78-123	≤ 25



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Appendix A

AFCEE QAPP

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Table 7.2.26-3. Summary of Calibration and QC Procedures for Method SW7841

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7841	Thallium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient $\geq 0.995$ for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected $\geq$ RL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration

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## Appendix A

Table 7.2.26-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7841	Thallium	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.26-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected $\geq$ RL	Correct problem then re-prepare and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.26-2	Correct problem then re-prepare and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

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## Appendix A

Table 7.2.26-3. Continued

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7841	Thallium	Dilution test; five-fold dilution test	Each preparatory batch	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) dilution test not run (2) RPD $\geq 10\%$
		Recovery test	When dilution test fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.26-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL

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## Appendix A

Table 7.2.26-3. Concluded

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
SW7841	Thallium	MDL study	Once per 12 month period	Detection limits established shall be $\leq \frac{1}{2}$ the RLs in Table 7.2.26-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and RL	none	none	none	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

**APPENDIX FSP-B**  
**DATA VALIDATION FORMS**

687 428

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### LABORATORY DATA PRELIMINARY REVIEW CHECKLIST

Page 1 of 4

Project : \_\_\_\_\_

Case Number: \_\_\_\_\_

Data Type(s): \_\_\_\_\_ (See list below)

Sample Matrix (Soil/Water): \_\_\_\_\_

Total Number of Samples Shown on Lab ID List: \_\_\_\_\_

Validated by: \_\_\_\_\_

Date: \_\_\_\_\_

QC by: \_\_\_\_\_

Date: \_\_\_\_\_

Comments: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Data Type:

Organics

Inorganics

Anion

### Exhibit 1 Laboratory Data Preliminary Review Checklist

**LABORATORY DATA PACKAGE DETAIL FORM**

Page 2 of 4

Project: \_\_\_\_\_

Case #: \_\_\_\_\_

Field Sample ID	Lab ID	Analysis (see below)	Date Sampled	Comments
1.				
2				
3				
4.				
5				
6				
7				
8				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				

ANALYSIS:	A: Organics	B: Inorganics	C. Anion
	Volatiles	Metals	Fluoride
	Semivolatiles	Cyanide	Chloride
	Pesticides	Mercury	Sulfate
	Full TCLP		Sulfide
	Herbicides		Nitrate
	TPH		Nitrite
	BTEX		Ammonia

**Exhibit 2**  
**Laboratory Data Package Detail Form**



**LABORATORY ANALYSIS DATA SHEETS CHECKLIST**

Page 3 of 4

Project: \_\_\_\_\_

Case # \_\_\_\_\_

Reviewer: \_\_\_\_\_

DATE \_\_\_\_\_

Validated \_\_\_\_\_

Final Disposition of Data Package. \_\_\_\_\_

	✓COMPLETE
1. Read Case Narrative	1.
a) Verify all statements made in Case Narrative	a. _____
b) Note any discrepancies for test and results	b. _____
c) Check "Date Received" noted on Laboratory ID/Case Narrative ID list against "Date Received" recorded on all forms.	c. _____
d) Check Case Narrative for any sample problems or discrepancies (e.g. Missed holding times, broken samples, improperly collected)	d. _____
2. Compare Laboratory ID List with sample IDs	2
a) Verify proper recording of sample ID with respect to Alpha and Numeric presentation on all sheets.	a. _____
3. Compare Laboratory ID List with Chain-of-Custody(COC) forms	
a) Check COC "Date Received" to ensure it matches with Case Narrative/Laboratory List	a. _____
b) Check COC sample ID against lab sample Data Sheets	b. _____
c) Check analysis requested on COC to ensure it matches with the analysis performed by lab	c. _____
d) If samples have been subcontracted to a different lab, verify that original COC and any subsequent COCs are with data package.	d. _____
4. Data Sheets	
a) Verify a Data Sheet is present for all samples within the data package	a. _____
b) Verify the following information on Data Sheet.	b
1. Sample ID	b.1. _____
2. Lab ID	b.2. _____
3. Date Received	b.3. _____
4. Correct Page Numbers	b.4. _____
c) If samples have been subcontracted to a different lab, verify that all cross-references to samples numbers are correct.	c. _____
5. Review Data Package for the presence of the following documents	5.
a) Case Narrative/Laboratory Summary	a. _____
b) Method Reference and Summary	b. _____
c) Quality Assurance/Quality Control Data Package	c.
1. Calibrations/Detection Limits	c.1. _____
2. Tuning Performance	c.2. _____
3. Matrix Spikes/Duplicates	c.3. _____
4. Blanks	c.4. _____
d) Sample Data Reports	d. _____
e) Chain of Custody	e. _____

Addition of Checklist regarding analytical parameters = verify completion, copy kept in QC file.

**Exhibit 3**  
**Laboratory Analysis Data Sheets Checklist**

## LABORATORY DATA VALIDATION REPORT

Page 4 of 4

<b>Project:</b> _____  <b>Laboratory:</b> _____  <b>Sample #</b> _____ _____ _____ _____	<b>Case #:</b> _____  <b>Validation Level:</b> III or IV  _____ _____ _____ _____
---	--

Check if appropriate:    ☐ Additional samples are listed on the attached sheet.

**Laboratory Test Method(s):** \_\_\_\_\_  
 \_\_\_\_\_

The samples listed above appear in the data package that has been qualitatively reviewed. The general criteria used to determine the performance were based on an examination of the following information: (where applicable)

\*Sample analysis

\*Blanks

\*Holding Times

\*Surrogates / Recoveries

\*Calibration Curves

\*Lab Control Samples

\*Internal/Continuing Standards

\*Matrix Spikes/ Matrix Duplicates

**Note:** If any discrepancies exist which may lead to the invalidation of the data a separate form(s) will be attached along with the Data Review Sheets.

<b>Validated by:</b> _____	<b>Date:</b> _____
<b>QC approval initials:</b> _____	<b>Date:</b> _____

### Exhibit 4 Laboratory Data Validation Report

Page \_\_\_\_\_

Project: \_\_\_\_\_

Case Number: \_\_\_\_\_

### LABORATORY DATA REVIEW SHEET

ANIONS				
<b>1. HOLDING TIMES</b>				
• Were all holding times met for all of the analyses requested?		Yes	No	N/A
• Bromide (no preservation required); 28 days		Yes	No	N/A
• Sulfates (4°C); 28 days		Yes	No	N/A
• Sulfides(4°C pH > 9 with zinc acetate/sodium hydroxide); 7 days		Yes	No	N/A
• Chloride/Fluoride (no preservation required)		Yes	No	N/A
• 28 days Nitrate/nitrite		Yes	No	N/A
• Ammonia (4°C, pH <2 with sulfuric acid); 28 days		Yes	No	N/A
<b>2. CALIBRATION</b>				
• Were the instruments calibrated with the appropriate number of standards (NLT 3)?		Yes	No	N/A
• Were initial calibrations performed at the beginning of each analysis?		Yes	No	N/A
• Do correlation coefficients for the calibration curves fall within acceptable allowances? (> 0.995)		Yes	No	N/A
• Did all analytes meet the percent recovery criteria for initial or continuing calibration verification analyses? (ICV/CCV for all analytes %R should be between 80 - 120%)		Yes	No	N/A
<b>3. BLANKS</b>				
• Does the concentration of the sample exceed the action level or is it above the method detection level (MDL) but less than the action level?		Yes	No	N/A
• Was a preparation blank analyzed for each matrix, for every 20 samples, and for each digestion batch?		Yes	No	N/A
<b>4. LABORATORY CONTROL SAMPLES</b>				
• Do all LCS recoveries fall within acceptable recovery criteria (80 -120%)		Yes	No	N/A
<b>5. DUPLICATES/SPIKES</b>				
• If any duplicates were run, do they agree within $\pm 20\%$ of each other?		Yes	No	N/A
• Do spike recoveries meet the 75 - 125% recovery criteria for all samples?		Yes	No	N/A

If any of the above questions were answered "No", then a discrepancy form must be completed and attached to the validation package. In addition, report all other discrepancies noted in the Case Narrative on the Data Validation Report. Otherwise, qualify all results as valid and justifiable.

Validated by: \_\_\_\_\_

Date: \_\_\_\_\_

QC approval Initials: \_\_\_\_\_

Date: \_\_\_\_\_

### Exhibit 5 Laboratory Data Review Sheet - Anions

Page \_\_\_\_\_

Project: \_\_\_\_\_ Case Number: \_\_\_\_\_

**LABORATORY DATA REVIEW SHEET**

ORGANICS			
1	<b>HOLDING TIMES</b>		
	• Were all holding times met for all of the analyses requested?	Yes No N/A	
	VOA- unpreserved. Aromatics 7 days from sample collection date	Yes No N/A	
	Preserved Soil and water within 14 days of sample collection date	Yes No N/A	
	Soils Unpreserved and preserved within 14 days of sample collection date	Yes No N/A	
	BNA, Pest, PCB Water - Extracted within 7 days. analyzed within 40 days	Yes No N/A	
	Soils - Extracted within 14 days; analyzed within 40 days	Yes No N/A	
	TPH Soil and water analyzed within 28 days from date of collection Preserved @ 4°C; pH<2 with HCl for water samples	Yes No N/A	
2	<b>CALIBRATION</b>		
	VOA or BNA		
	Date of Initial Calibration: _____		
	Date(s) of Continuing Calibration: _____		
	Do all compounds have an RRF $\geq 0.05$ , %RSD $\leq 30$ , %D $\leq 25$	Yes No N/A	
	PEST/PCB		
	Linearity evaluation, %RSD $\leq 20$ ?	Yes No N/A	
	Was the RPD between calibration factors $\leq 25$ ?	Yes No N/A	
	Was the instrument calibrated with the appropriate number of standards (NLT 3) everyday of use?	Yes No N/A	
	TPH		
	Was an initial calibration performed at the beginning of each analysis with 3 to 5 standards?		
	Do correlation coefficients for the calibration curves fall within acceptable allowances? ( $\geq 0.995$ )	Yes No N/A	
	Do all calibration checks fall between 80 - 120%R of true value?	Yes No N/A	
3	<b>BLANKS</b>		
	• Does the concentration of the sample exceed the action level or is it above the method detection level (MDL) but less than the action level?	Yes No N/A	
	• Was a preparation blank analyzed for each matrix, for every 20 samples, and for each digestion batch?	Yes No N/A	
4.	<b>LABORATORY CONTROL SAMPLES (TPH only)</b>		
	• Do all LCS recoveries fall within acceptable recovery criteria 50 -100%	Yes No N/A	
5	<b>SURROGATES AND INTERNAL STANDARDS (VOA, BNA, PEST ONLY)</b>		
	• Do all surrogates compounds meet acceptable recoveries according to lab standards?	Yes No N/A	
	• IS area counts must be within 50% to +100%	Yes No N/A	
	• RT of IS must be within $\pm 30$ seconds of standard	Yes No N/A	
6	<b>DUPLICATES/SPIKES</b>		
	• If any duplicates were run, do they agree within $\pm 20\%$ of each other?	Yes No N/A	
	• Do spike recoveries meet the laboratory recovery criteria for all samples? (Specified by Individual Lab)	Yes No N/A	

If any of the above questions were answered "No", a discrepancy form must be completed and attached to the validation package Report all discrepancies noted in the Case Narrative on the Data Validation Report Otherwise, qualify all results as valid and justifiable

Validated by \_\_\_\_\_ Date \_\_\_\_\_

QC approval Initials \_\_\_\_\_ Date \_\_\_\_\_

**Exhibit 6**  
**Laboratory Data Review Sheet - Organics**

Project: \_\_\_\_\_ Case Number: \_\_\_\_\_ Sheet \_\_\_\_\_ of \_\_\_\_\_

**LABORATORY DATA REVIEW SHEET**

**INORGANICS**

**1. HOLDING TIMES**

- |   |     |    |     |
|---|-----|----|-----|
| • Were all holding times met for all of the analyses requested?         | Yes | No | N/A |
| (180 days from sample collection, pH < 2 for Metals,                    | Yes | No | N/A |
| 28 days from sample collection, pH < 2 for Mercury, 14 days from sample | Yes | No | N/A |
| collection, pH > 12 for Cyanides)                                       | Yes | No | N/A |

**2. CALIBRATION**

- |   |     |    |     |
|---|-----|----|-----|
| Were the instruments calibrated with the appropriate number of standards (NLT 3)?   | Yes | No | N/A |
| • Were initial calibration performed at the beginning of each analysis?   | Yes | No | N/A |
| • Do correlation coefficients for the calibration curves fall within acceptable allowances? (AA, Hg, and CN $\geq 0.995$ )            | Yes | No | N/A |
| • Were the calibrations standard analyzed at a minimum frequency of every 10% or 2 hours during analysis, whichever is more frequent? | Yes | No | N/A |
| • Was a standard at 2 x CRDL analyzed for all ICP analyses?   | Yes | No | N/A |
| • Did all analytes meet the percent recovery criteria for initial or continuing calibration verification analyses?                    | Yes | No | N/A |
| ICV\CCV for   |     |    |     |
| Metals 90 - 110%  | —   | —  | —   |
| Mercury 80 - 120%   | —   | —  | —   |
| Cyanide 85 - 115%   | —   | —  | —   |

**3. BLANKS**

- |   |     |    |     |
|---|-----|----|-----|
| • Does the concentration of the sample exceed the action level? Is it above the IDL but less than the action level? | Yes | No | N/A |
| • Was a preparation blank analyzed for each matrix, for every 20 samples, and for each digestion batch?             | Yes | No | N/A |
| • Was a calibration blank analyzed every 10 samples or every 2 hr., whichever is more frequent?                     | Yes | No | N/A |
| • Did any blank have an absolute value > 2xs the IDL? (If yes, this indicates instrumentation problems)             | Yes | No | N/A |

**4. LABORATORY CONTROL SAMPLES**

- |  |     |    |     |
|--|-----|----|-----|
| • Do all LCS recoveries fall within acceptable recovery criteria 80 -120% (note: Sb and Ag do not have control limits) | Yes | No | N/A |
| • Was a LCS analyzed for every matrix, every digestion batch, and every 20 samples?                                    | Yes | No | N/A |

**5. DUPLICATES/SPIKES**

- |  |     |    |     |
|--|-----|----|-----|
| • If any duplicates were run, do they agree within $\pm 20\%$ of each other? | Yes | No | N/A |
| • Do spike recoveries meet the 85 - 115% recovery criteria for all samples?  | Yes | No | N/A |

If question (\*) was answered with a yes, or if any of the other above questions were answered with a no then a discrepancies form must be completed and attached to the validation package. In addition, report all other discrepancies noted in the Case Narrative on the Data Validation Report. Otherwise, qualify all results as valid and justifiable.

Validated by: \_\_\_\_\_  
QC approval Initials: \_\_\_\_\_

Date: \_\_\_\_\_  
Date: \_\_\_\_\_

**Exhibit 7**  
**Laboratory Data Review Sheet – Inorganics**



Sheet \_\_\_\_\_ of \_\_\_\_\_

## DATA VALIDATION DISCREPANCY REPORT

**Project:**

Laboratory:

Case No.

**Matrix:**

**Validation Level: III or IV**

Validated By:

Date:

QC By:

Date:

The following table lists any discrepancies found in the validation review. The affected samples are noted and the action taken is described in the comment section.

[illegible]

Comments: \_\_\_\_\_

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

Total Pages

## Exhibit 8

### Data Validation Discrepancy Report

**FINAL PAGE**

**ADMINISTRATIVE RECORD**

**FINAL PAGE**